PB-229 985

A STUDY OF FECAL COLIFORM LEVELS IN GEORGIA RECREATIONAL WATERS

Federal Water Pollution Control Administration
Athens, Georgia

September 1969

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U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST WATER LABORATORY
TECHNICAL SERVICES
ATHENS, GEORGIA

GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

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RECOMMENDATIONS

The following recommendations are based on the general philosophy that the almost nonexistent incidence of waterborne disease reported in the State of Georgia precludes the establishment of fecal coliform criteria on an epidemiological basis. In the absence of epidemiological data, the suggested criteria are based on existing fecal coliform levels in high quality recreational waters.

These recommendations are applicable to inland and coastal waters of the State of Georgia. Application of these recommendations outside this specific geographical area may be inappropriate.

1. The geometric mean will be used as the method of criteria expression. This technique will be applied to no less than four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours.
2. Coastal waters will be considered separate from freshwaters for the purpose of establishing numerical criteria. The coastal water fecal coliform level will not exceed a geometric mean of 100/100 ml.
3. Reservoir waters will be considered separate from streams for the purpose of establishing numerical criteria. The reservoir water fecal coliform level will not exceed a geometric mean of 300/100 ml.
4. The freshwater stream fecal coliform level will not exceed a geometric mean of 500/100 ml.

5. High levels resulting from storm runoff will be included in calculating geometric mean values.
6. Seasonal application of the criteria is not considered justified.
7. The use of sanitary survey information to identify potential pathogen sources will be emphasized as equal in importance to application of fecal coliform criteria.

TABLE I

WATERS CLASSIFIED FOR RECREATION IN GEORGIA 1/

WATER BODY	DESCRIPTION OF REACH
Chattahoochee River	Headwaters to Buford Dam
Chattahoochee River	U. S. Hwy. 27, Franklin, Georgia, to West Point Dam
Chattahoochee River	Osanippa Creek to Columbus, Georgia, (14th Street Bridge)
Chattahoochee River	Cowikee Creek to Great Northern Paper Co.
Chattahoochee River	Ga. Hwy. 91 (Neal's Landing) to Jim Woodruff Dam
Flint River	Ga. Hwy. 27 to Albany (Ga. Power Company's Dam at Lake Worth)
Flint River	Bainbridge (U. S. Hwy. 84) to Jim Woodruff Dam
Coosa River	At the Alabama State Line
Tennessee River Basin	
Hiawassee River (Including Lake Chatuge)	Headwaters to State Line
Nottely River (Including Lake Nottely)	Headwaters to State Line
Toccoa River (Including Blue Ridge Lake)	Headwaters to State Line
Savannah River	Ga.-N.C. State Line to Clark Hill Dam
Savannah River	Ft. Pulaski (Mile 0) to Open Sea and all Littoral Waters of Tybee Island
Ogeechee River	U. S. Hwy. 17 to Open Sea and Littoral Waters of Skidaway and Ossabaw Islands
Little Ogeechee River	South End of White Bluff Road to Open Sea
Other Coastal Waters	All Littoral Waters on the Ocean Side of Cumberland, Jekyll, St. Simons, Sea, Sapelo, and St. Catherines Island

1/ Predominant types of recreation include swimming, skiing, and boating.

TABLE II

PERCENTAGE CUMULATIVE FREQUENCY OF INDIVIDUAL MPN COUNTS
FOR DIFFERENT WATER TYPES

COUNT/100 ml	PERCENTAGE OF INDIVIDUAL COUNTS EQUAL TO OR LESS THAN				
	ALL COUNTS*	CLEAN ONLY	STREAMS	RESERVOIRS	COASTAL
100	56	71	25	75	83
200	65	78	40	80	93
300	72	83	49	85	95
400	76	86	56	86	97
500	82	91	64	90	97
600	83	91	65	90	98
700	83	91	66	90	98
800	85	92	70	91	98
900	85	92	70	93	98
1000	87	94	73	93	98
1100	87	94	74	93	98
1200	88	94	76	93	98
1300	88	94	76	93	98
1400	89	94	78	93	98
1500	89	94	78	93	98
1600	90	94	79	93	98
1700	90	94	80	93	98
1800	91	94	82	93	98
1900	91	94	82	93	98
2000	91	100	82	93	98

*Freshwater only

FIGURE 1

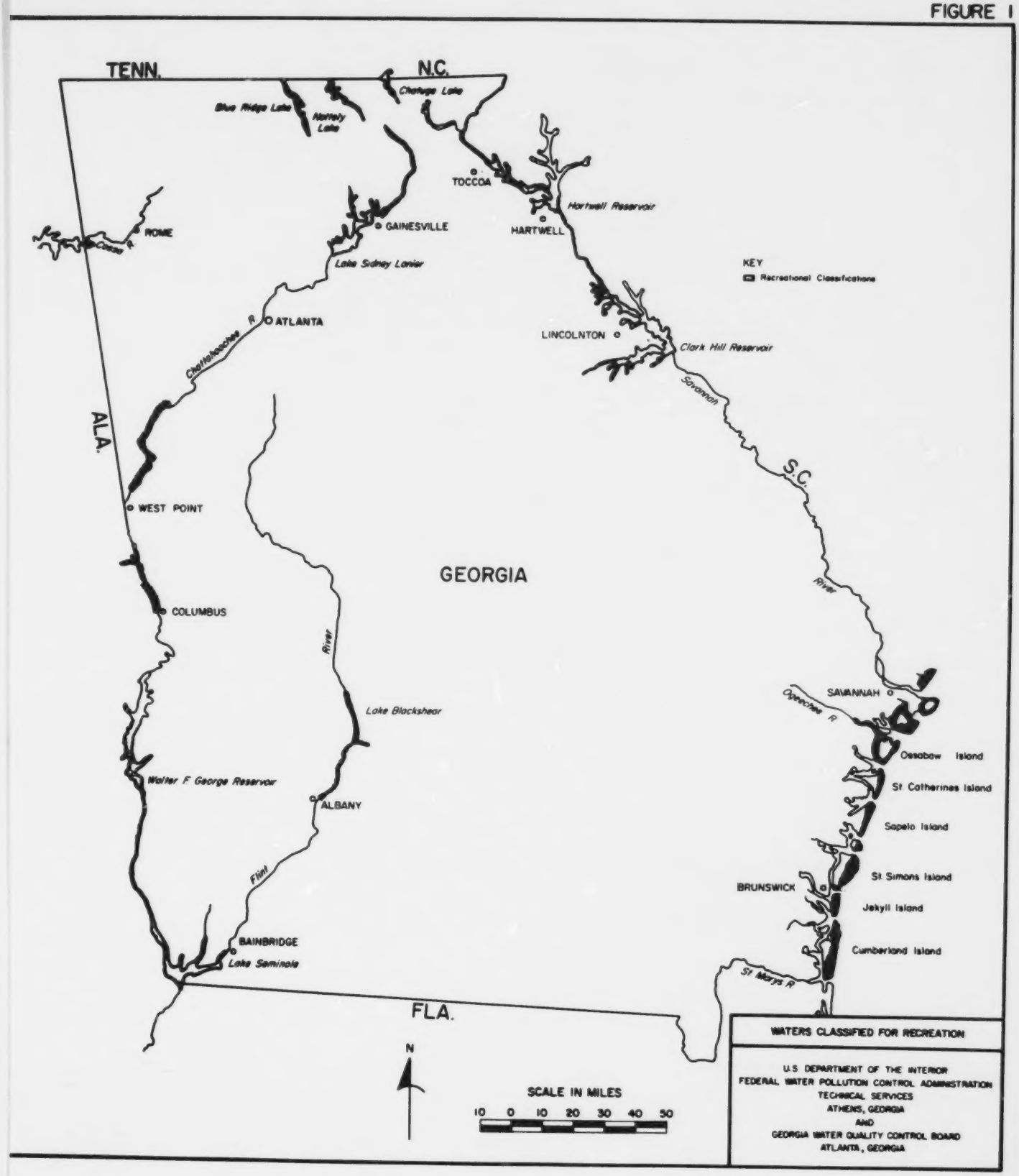
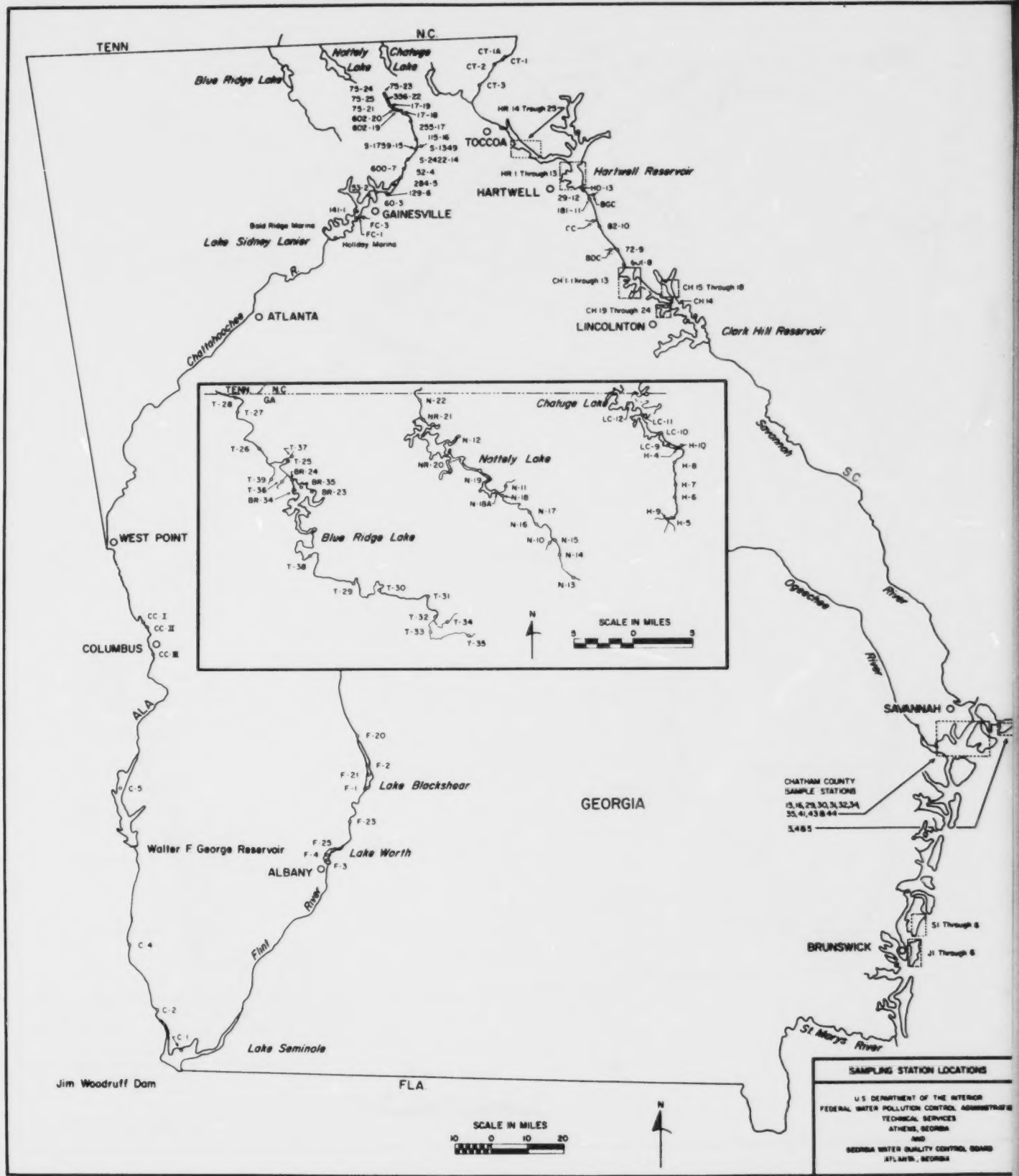

TENN.
N.C.
Chatuge Lake
Blue Ridge Lake
Nottely Lake
TOCCOA
Hartwell Reservoir
HARTWELL
GAINESVILLE
ROME
Coosa R.
Lake Sidney Lanier
ATLANTA
Chattahoochee R.
LINCOLNTON
Clark Hill Reservoir
Savannah
S.C.
ALA.
WEST POINT
GEORGIA
COLUMBUS
River
Lake Blackshear
Walter F. George Reservoir
ALBANY
Flint
BAINBRIDGE
Lake Seminole
FLA.
SAVANNAH
Ogeechee R.
Ossabaw Island
St Catherines Island
Sapelo Island
St Simons Island
BRUNSWICK
Jekyll Island
Cumberland Island
St Marys R.
KEY
Recreational Classification
N
SCALE IN MILES
10 0 10 20 30 40 50
WATERS CLASSIFIED FOR RECREATION
U.S DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
ATHENS, GEORGIA
AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 2


TENN
N.C.
Nottely Lake
Chatuge Lake
Blue Ridge Lake
TOCCOA
HARTWELL
Hartwell Reservoir
GAINESVILLE
Lake Sidney Lanier
ATLANTA
Chattahoochee R.
LINCOLNTON
Clark Hill Reservoir
Savannah R.
S.C.
WEST POINT
COLUMBUS
ALA.
Opelchee River
SAVANNAH
Lake Blackshear
GEORGIA
Walter F George Reservoir
Lake Worth
ALBANY
Flint River
Lake Seminole
Jim Woodruff Dam
FLA.
BRUNSWICK
St Marys River
CHATHAM COUNTY SAMPLE STATIONS
13,16,29,30,31,32,34
35,41,43&44
3,4&5
SCALE IN MILES
SAMPLING STATION LOCATIONS
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
ATHENS, GEORGIA
AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

SUMMARY

In approving the Georgia Water Quality Standards on July 18, 1967, the Secretary of the Interior requested a review of the bacterial criteria for recreational waters. This review was in the form of a joint FWPCA-GWQCB study of existing fecal coliform levels in Georgia's recreational waters.

The lack of epidemiological data on waterborne illness among swimmers in Georgia precluded an epidemiologically-based criterion. Consequently, the recommended bacterial criteria for recreational waters are based on existing fecal coliform levels found in known high-quality waters.

Field studies to determine existing fecal coliform levels were initiated in August 1967 and terminated in November 1968. During the study period, 1,392 fecal coliform analyses were made from 910 samples collected at 136 freshwater and 27 coastal water stations.

To assist in the data analysis, sanitary surveys were made to determine the influence of wastes on the measured fecal coliform densities. These surveys categorized stations as: (a) those with no obvious wastes present (clean), (b) those affected by livestock, and (c) those affected by domestic waste discharges. Seventy percent of the sites sampled were designated clean, 14 percent affected by livestock wastes, and 16 percent by varying degrees of domestic wastes.

Specific recommendations for criteria are presented in the Recommendations section.

AUTHORITY

The study reported here was conducted under the following authorities:

- Under Section 5(a) of the Federal Water Pollution Control Act, as Amended, the Department of the Interior is encouraged to cooperate with state agencies in studies relating to control of water pollution.
- Under Section 5(2 & 4) of the Georgia Water Quality Control Act, as Amended, the Georgia Water Quality Control Board is authorized to cooperate with agencies of the Federal Government and to survey the waters of the State of Georgia.

INTRODUCTION

Stream quality criteria for "Recreational Waters" were included in Georgia's Water Quality Standards in 1967. In a review of these standards, the Federal Water Pollution Control Administration (FWPCA), U.S. Department of the Interior, expressed concern over the fecal coliform concentrations set forth as maximum permissible limits.[1/] Following discussions between FWPCA and the Georgia Water Quality Control Board (GWQCB), it was agreed a cooperative study would be conducted on Georgia's "Recreational Waters" by the two agencies. The Secretary of the Interior approved Georgia's Standards on July 18, 1967, with the understanding that the study would be conducted.[2/]

The study was designed to determine the indicator levels for waters classified for recreational use by the State of Georgia. The waters included those of the highest quality found in the state. Sampling locations for this study were selected to: (a) reflect the bacterial quality of recreational waters with nearby municipal, agricultural and/or industrial waste sources; (b) reflect the bacterial quality of recreational waters with no known waste sources nearby; (c) reflect the bacterial quality of recreational waters over

---

1/ Bacteria: Fecal coliform concentrations for recreational waters not to exceed a mean of 1,000 per 100 ml (MPN) based on at least four samples taken over a 30-day period, and not to exceed 4,000 per 100 ml in more than five percent of the samples taken in any 90-day period.

2/ Secretary's letter - Appendix A

a wide geographical area (entire state); (d) reflect the effects that surface water runoff has on bacterial densities in recreational waters; and (e) reflect the bacterial quality of different types of waters (fresh versus coastal waters, and streams versus reservoirs). Station locations, descriptions and waste classifications are found in Appendices B, C, and D.

It was anticipated that acquisition of current fecal coliform data, together with sanitary surveys, would provide a foundation on which Georgia's Standards could be reviewed by the two agencies.

Any bacterial criterion should be a guide to quality determination rather than merely a value never to be exceeded. Available sanitary survey information and microbiological data should be considered in final water quality determinations. Furthermore, bacterial criteria are interim rather than permanent numbers, since improvements in microbiological techniques and expanded epidemiological data may bring about future criteria changes.

The public is most concerned about the health-safety of recreational waters. Besides being extremely important, this is probably the most difficult aspect of recreational water use to define. The presence of "waterborne" infectious microorganisms is not necessarily the result of domestic waste discharges. They may result from an ever-present, uncontrollable animal population in an area or from the water user himself. For this reason, prevention of all potential infectious agents from entering a recreational water is impossible.

Evaluation of the relative safety of a recreational water from a health standpoint requires the use of a bacterial indicator of enteric pathogen presence. Although this is an indirect approach

of determining pathogen presence, the time required, lack of methodology, the complexities of existing methodologies, and the nature of pathogen presence, rule out direct pathogen measurement as an effective safety criterion. At present, the indicator of choice is the fecal coliform group (FC).

The relationship between illness among swimmers and water quality has yet to be fully established. Although some epidemiological evidence exists, the majority of information is not conclusive. Results of three studies conducted by the U.S. Public Health Service on illness among swimmers revealed that a slightly higher incidence of minor infections resulted from swimming in water where the total coliform density exceeded 2400/100 ml. (1) Swimmers, however, have a higher incidence of minor infections and irritations than non-swimmers regardless of the water quality. Presently, epidemiological evidence is lacking that will allow establishment of an indicator threshold level above which significant health-effects will result. No indicator level will insure a water user complete safety.

METHODS OF STUDY

SAMPLING

All samples were collected near the surface using selected grab techniques. Most stream samples were collected at mid-stream unless waste source information warranted left and/or right bank collection. All samples were collected in sterile containers and placed in ice until analysis. Most samples were analyzed within six hours after collection, with the majority analyzed within four hours.

Most stations were sampled on several different days although not necessarily on consecutive days. Samples were taken to reflect both climatological conditions and seasonal bacterial variations.

Coastal sampling was handled primarily through the GWQCB, which established a long-term bacteriological studies contract with the Chatham County Health Department, Savannah, Georgia. The contract provided for weekly sampling of all stations during the recreational season. The Health Department's Engineering and Sanitation staff collected the samples and delivered them to the laboratory, usually within two hours of collection. The samples were processed immediately.

FECAL COLIFORM ENUMERATION

The fecal coliform test procedure outlined in Standard Methods (3) for the MPN multiple tube dilution was used. The procedure employs the standard presumptive test using Lauryl Tryptose Broth followed by fecal coliform confirmation using E. C. Medium at an elevated temperature of $44.5^{o}C \pm 0.5^{o}C$ (waterbath).

Four hundred and eighty-two samples were split and fecal coliform densities determined using both MPN and membrane (MF) procedures simultaneously. The MF procedure used was that of Geldreich et al (4) which employs M-FC broth and an incubation temperature of $44.5^{o}C \pm 0.5^{o}C$ (waterbath).

RESULTS AND DISCUSSION

The study was initiated in August 1967 and terminated in November 1968. Table I lists those waters classified for recreation and Figure 1 depicts these areas.

Station locations and their waste-type classifications are contained in Appendices B, C and D and shown in Figure 2. During the study 136 freshwater and 27 coastal water stations were sampled for fecal coliform densities.

A total of 1,392 fecal coliform determinations were made on 910 samples from the freshwater stations. Of the 1,392 analyses, 910 were made using the MPN method and the remaining 482 were made using the MF method. Since the Georgia Standards specify the use of the multiple tube procedure as the enumerative procedure of choice, only those results collected using this procedure are discussed.

A total of 341 FC analyses were made on coastal water sampled using the MPN method. Data from the coastal samples are treated separately from the freshwater data discussed in this report.

A summary of all fecal coliform data is contained in Appendices E, F and H.

INDIVIDUAL COUNTS

Table II shows the percentage cumulative frequency for individual MPN values for several water-types and Figures 3 and 4 are plots of these values (excluding coastal data). When all freshwater MPN counts are combined, 56 percent of these counts are equal to or

less than 100 FC/100 ml. There is a gradual increase in count occurrence until the 500 FC/100 ml level is reached, after which a decided "leveling off" occurs (Figure 3). At the 500 FC/100 ml level, 82 percent of all the freshwater counts had occurred.

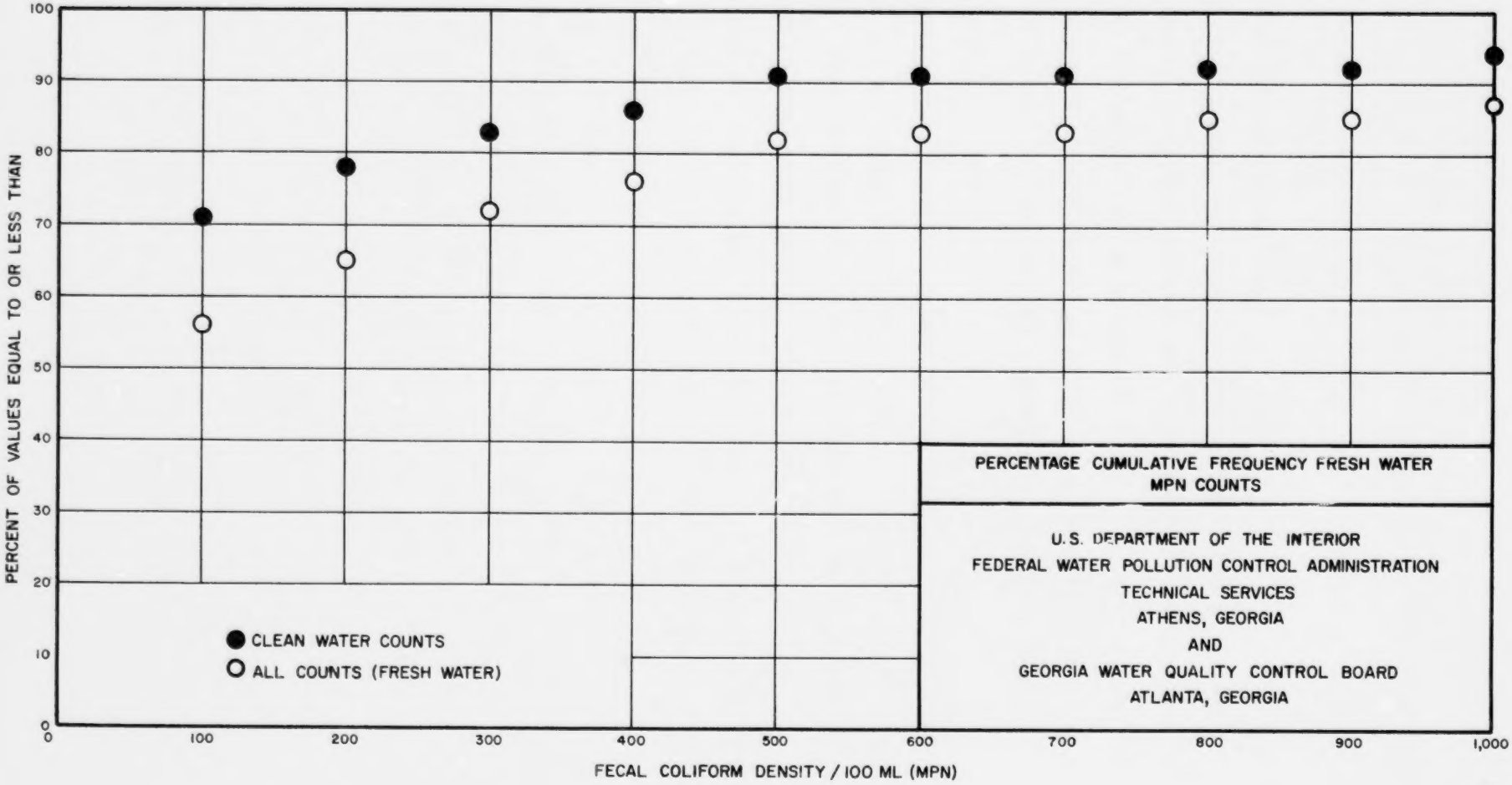
A comparison of counts for streams versus reservoirs shows 25 percent of the FC counts on stream samples were equal to or less than 100/100 ml, whereas, 75 percent of the reservoir counts were equal to or less than 100/100 ml (Table II and Figure 4). Reasons for differences in these bacterial densities are: contrast in retention time, dilution, possible dieoff rate and point source wastes in reservoirs versus that in streams.

Clean station counts and reservoir counts are similar in count frequency. Part of this similarity relates to the fact that most of the clean stations are also reservoir stations.

From the plot (Figure 4) there appears to be a "breakpoint" [1/] at the 500 FC/100 ml level after which any increase in count level results in only a slight increase in count occurrence up to the 1,000/100 ml level.

Count occurrence for the coastal waters is shown in Table II. These data show 83 percent of all FC counts were equal to or less than 100/100 ml, and 98 percent equal to or less than 600/100 ml. Some of the coastal stations were affected by domestic waste discharges; however, as shown, the bacterial quality of the coastal waters is considered good.

1/ Breakpoint - a point on the cumulative frequency curve above which there is only a slight increase in count occurrence.


PERCENT OF VALUES EQUAL TO OR LESS THAN
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
1,000
FECAL COLIFORM DENSITY / 100 ML (MPN)
CLEAN WATER COUNTS
ALL COUNTS (FRESH WATER)
PERCENTAGE CUMULATIVE FREQUENCY FRESH WATER
MPN COUNTS
U.S. DEPARTMENT OF THE INTERIOR
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TECHNICAL SERVICES
ATHENS, GEORGIA
AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 3

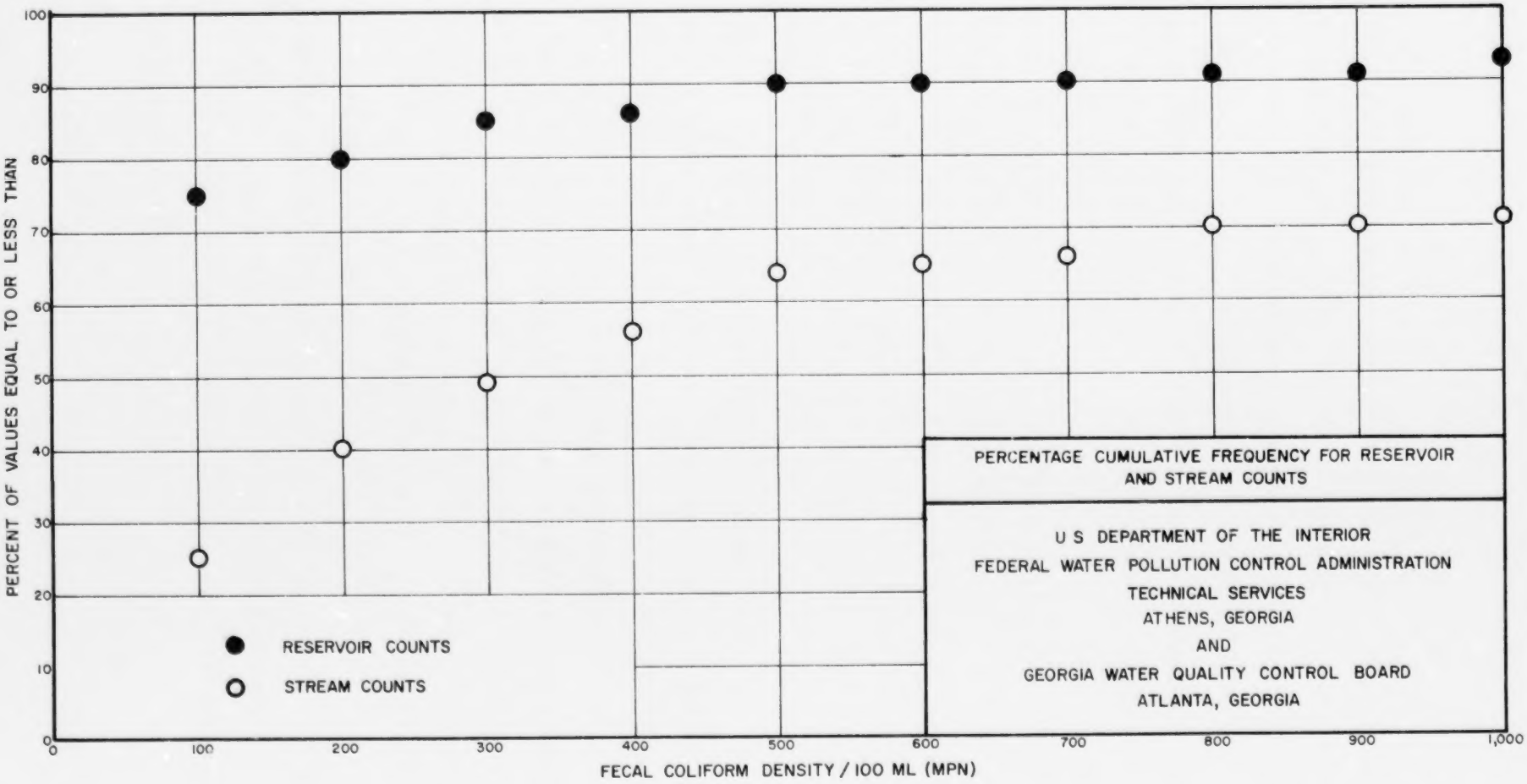
PERCENT OF VALUES EQUAL TO OR LESS THAN
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
1,000
FECAL COLIFORM DENSITY / 100 ML (MPN)
RESERVOIR COUNTS
STREAM COUNTS
PERCENTAGE CUMULATIVE FREQUENCY FOR RESERVOIR AND STREAM COUNTS
U S DEPARTMENT OF THE INTERIOR
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FIGURE 4

INDIVIDUAL STATIONS

The freshwater stations meeting various mean fecal coliform levels are shown in Tables III and IV and graphically presented in Figures 5 through 8. Both arithmetic and geometric mean treatments of these data are presented.

Figures 5 and 6 show the percentage of all freshwater stations meeting various mean fecal coliform levels. An increase in the percentage of these stations meeting the various mean densities is shown up to 600/100 ml and 700/100 ml for arithmetic and geometric presentations respectively. At these levels there are breaks in the curves; with 76 percent stations meeting the respective levels. These figures reflect a greater percentage of stations meeting the various mean levels where the geometric rather than the arithmetic mean is used.

After reaching the respective breakpoints, further increases in count level produce insignificant increases in the percentage of stations meeting these higher levels. A doubling of the 600 and 700/100 ml levels results in only an additional 7 percent and 4 percent of the remaining stations meeting these higher levels.

EFFECT OF WASTE

Clean water stations and stations affected by domestic or livestock wastes are compared in Figures 5 and 6. A pattern similar to that exhibited by all the freshwater stations taken together is shown when only the clean water stations are considered. The only differences are a higher percentage of the clean water stations meets lower FC densities, and the breakpoints occur at lower densities.

TABLE III

STATION CATEGORIES MEETING DIFFERENT ARTHMETIC MEAN
FECAL COLIFORM LEVELS - MPN

MEAN/ 100 ML	PERCENTAGE OF STATIONS MEETING VARIOUS MEAN DENSITIES					
	ALL STATIONS*	CLEAN STATIONS	STREAM STATIONS	CLEAN STREAM STATIONS	RESERVOIR STATIONS	COASTAL STATIONS
100	54	72	13	25	79	67
200	62	81	22	56	83	85
300	68	87	29	56	89	89
400	71	92	31	63	93	92
500	73	93	36	63	93	92
600	76	96	44	75	94	92
700	77	96	47	75	94	92
800	77	96	47	75	94	96
900	79	96	53	75	94	96
1000	81	96	55	75	94	96
1500	85	99	60	81	98	100
2000	88	99	69	88	99	100

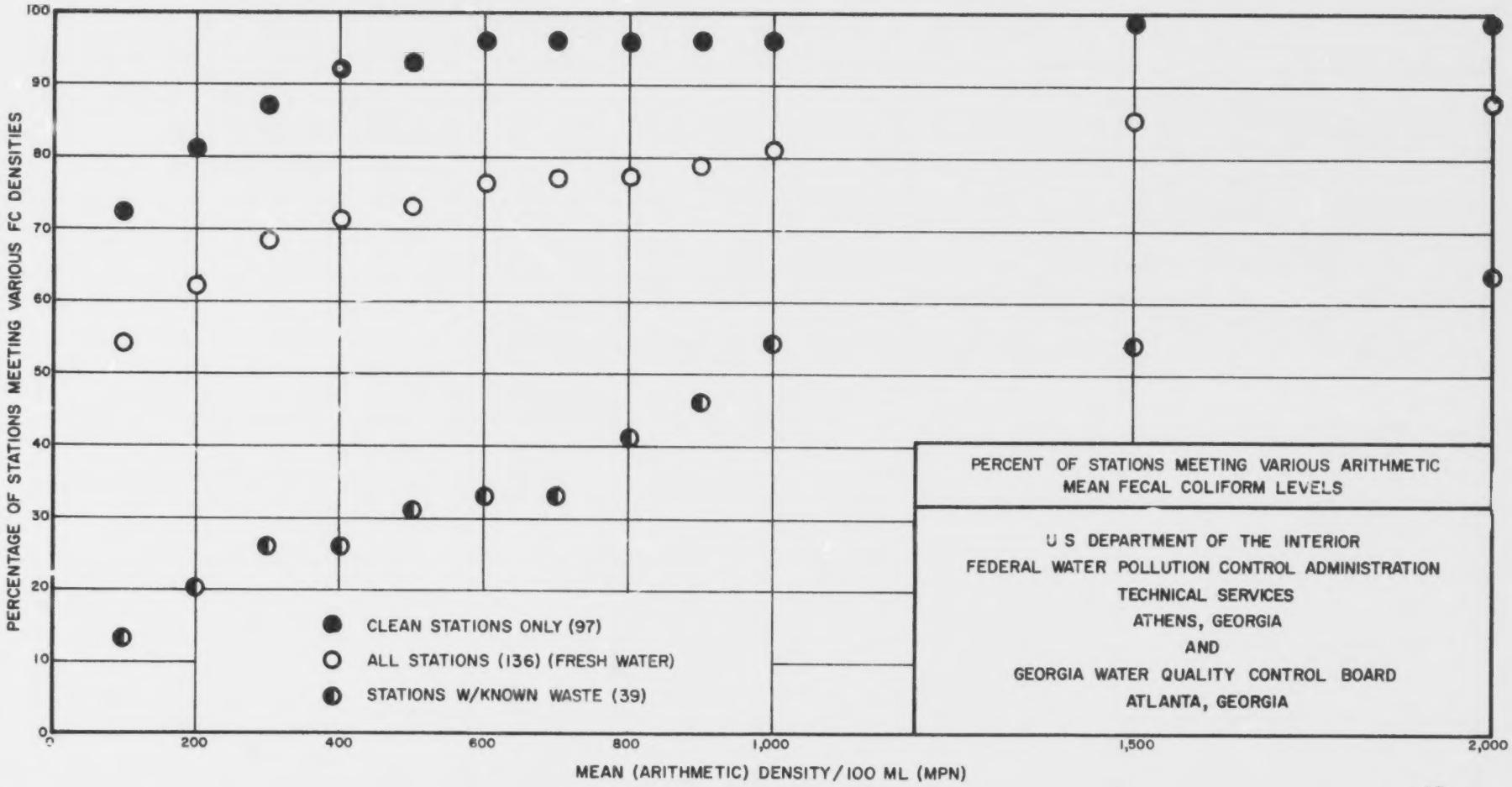
* Freshwater only

TABLE IV

STATION CATEGORIES MEETING DIFFERENT GEOMETRIC MEAN
FECAL COLIFORM LEVELS - MPN

MEAN /100 ml	PERCENTAGE OF STATIONS MEETING VARIOUS MEAN DENSITIES					
	ALL STATIONS*	CLEAN STATIONS	STREAM STATIONS	CLEAN STREAM STATIONS	RESERVOIR STATIONS	COASTAL STATIONS
100	68	88	22	50	92	100
200	73	92	37	69	94	100
300	79	96	43	69	98	100
400	81	97	48	81	98	100
500	84	99	56	94	98	100
600	87	99	65	94	98	100
700	90	99	69	94	98	100
800	90	99	74	94	98	100
900	91	99	76	94	98	100
1000	93	99	80	94	98	100
1500	98	100	91	100	99	100
2000	98	100	93	100	99	100

*Freshwater only


PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN (ARITHMETIC) DENSITY/100 ML (MPN)
CLEAN STATIONS ONLY (97)
ALL STATIONS (136) (FRESH WATER)
STATIONS W/KNOWN WASTE (39)
PERCENT OF STATIONS MEETING VARIOUS ARITHMETIC MEAN FECAL COLIFORM LEVELS
U S DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
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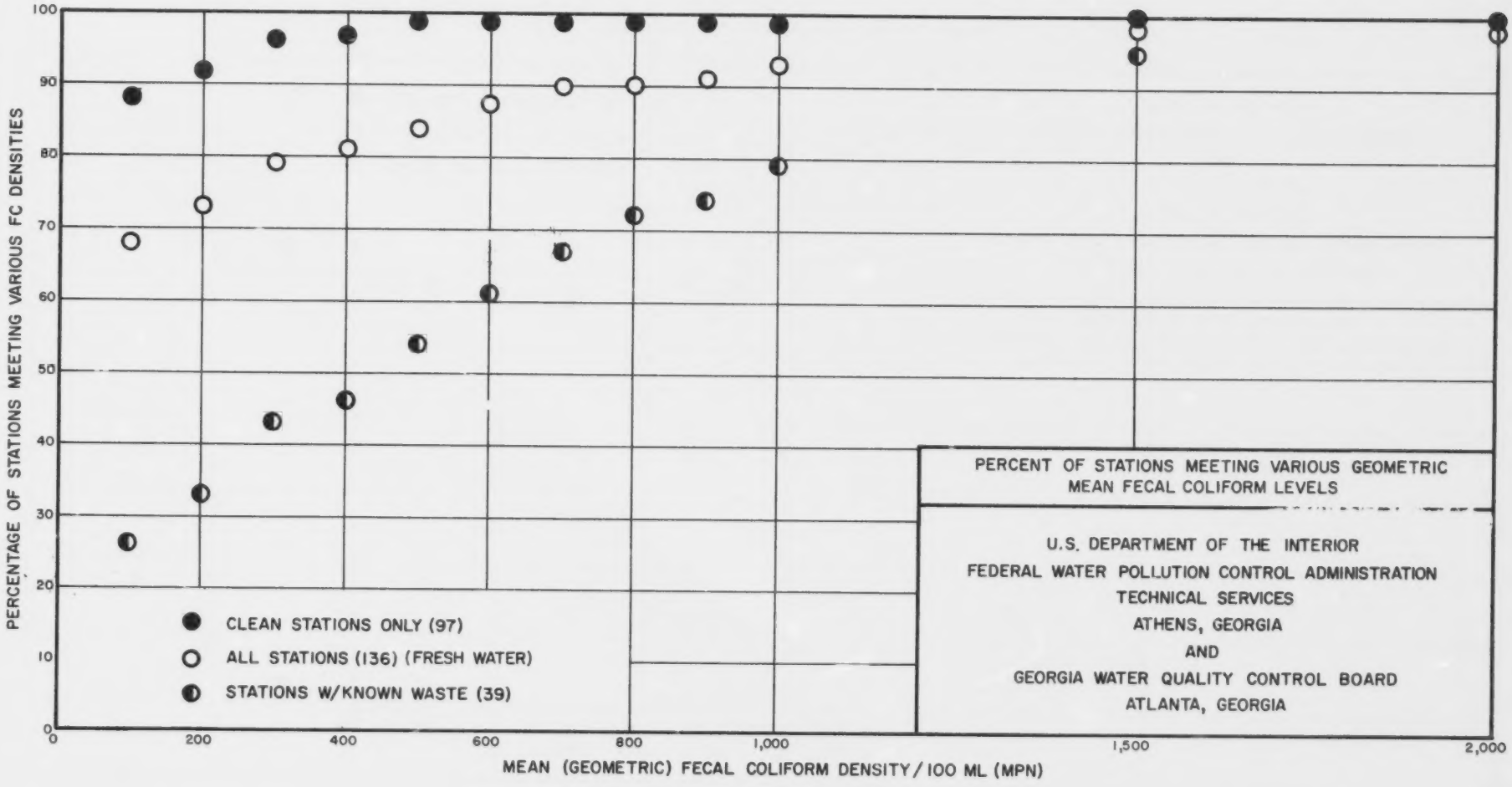
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 5


PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN (GEOMETRIC) FECAL COLIFORM DENSITY/100 ML (MPN)
CLEAN STATIONS ONLY (97)
ALL STATIONS (136) (FRESH WATER)
STATIONS W/KNOWN WASTE (39)
PERCENT OF STATIONS MEETING VARIOUS GEOMETRIC MEAN FECAL COLIFORM LEVELS
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
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ATHENS, GEORGIA
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FIGURE 6

The curves representing all freshwater stations are most influenced by the clean water stations which comprise about two-thirds of the stations.

The waste-affected stations show less defined curves than do the clean water stations (Figures 5 and 6). This is especially true in the arithmetic data presentation (Figure 5). A less erratic curve is shown with the geometric presentation due to a "smoothing" effect of the occasional high and low values.

Table V lists the individual freshwater stations that cannot meet various geometric mean fecal coliform levels and the percentage of wastes classifications represented. All stations unable to meet a geometric mean of 500/100 were influenced by some type of waste.

STREAM VERSUS RESERVOIRS

A comparison of stream and reservoir stations meeting various FC levels is shown in Figures 7 and 8. The reservoir curves show breakpoints at mean FC densities of 300 and 400/100 ml for the geometric and arithmetic treatments, respectively. At these points, 98 percent and 93 percent of the stations were able to meet the respective levels. A doubling of these breakpoint levels results in 0 percent and 1 percent of the remaining stations meeting the higher levels.

Figures 7 and 8 show a gradual increase in the number of stream stations meeting various FC levels up to 2000/100 ml without a distinct breakpoint. At the mean FC level of 1000/100 ml, 55 percent and 80 percent of the stations meet this level for the arithmetic and geometric treatments respectively.

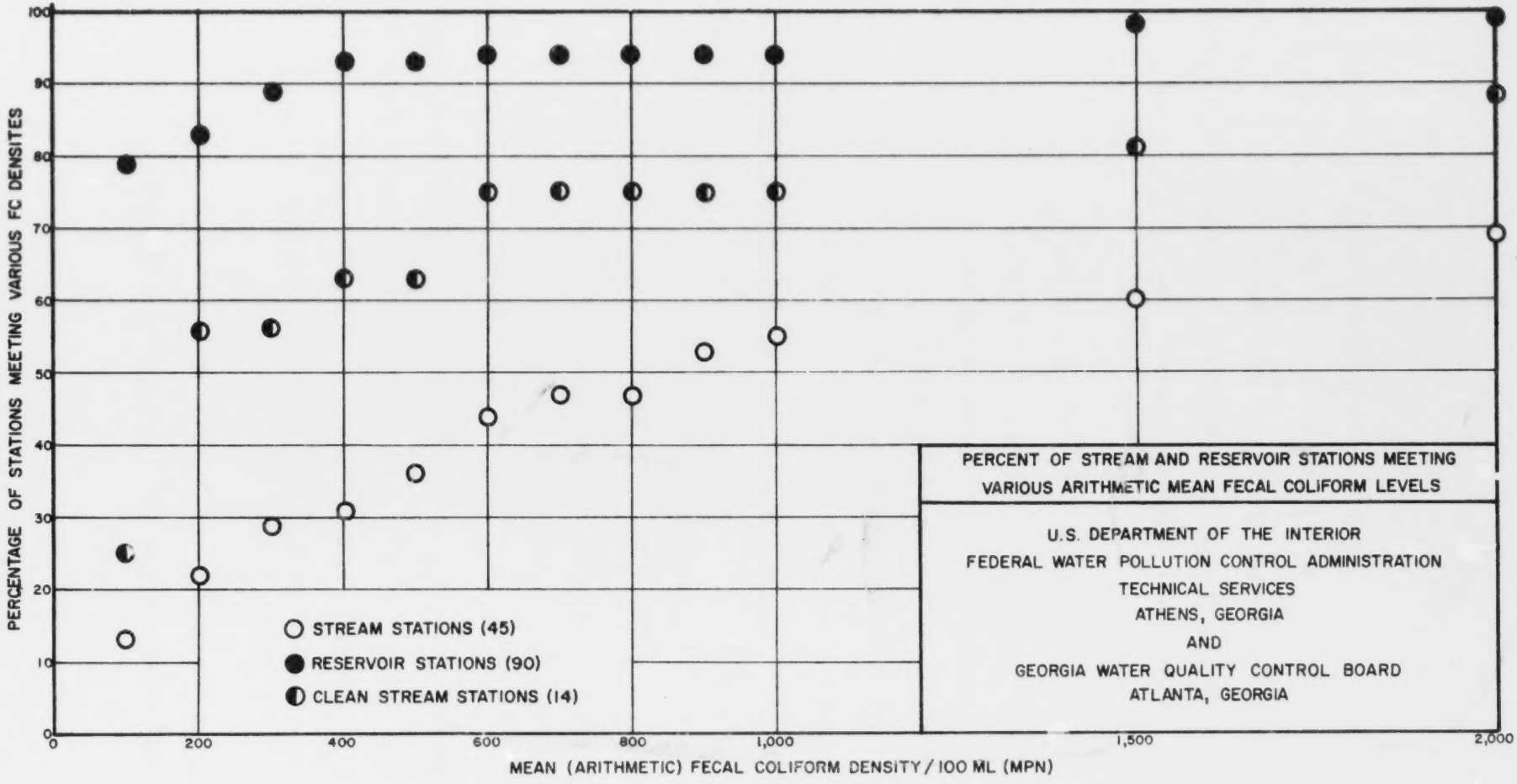
PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN (ARITHMETIC) FECAL COLIFORM DENSITY / 100 ML (MPN)
STREAM STATIONS (45)
RESERVOIR STATIONS (90)
CLEAN STREAM STATIONS (14)
PERCENT OF STREAM AND RESERVOIR STATIONS MEETING
VARIOUS ARITHMETIC MEAN FECAL COLIFORM LEVELS
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
ATHENS, GEORGIA
AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 7

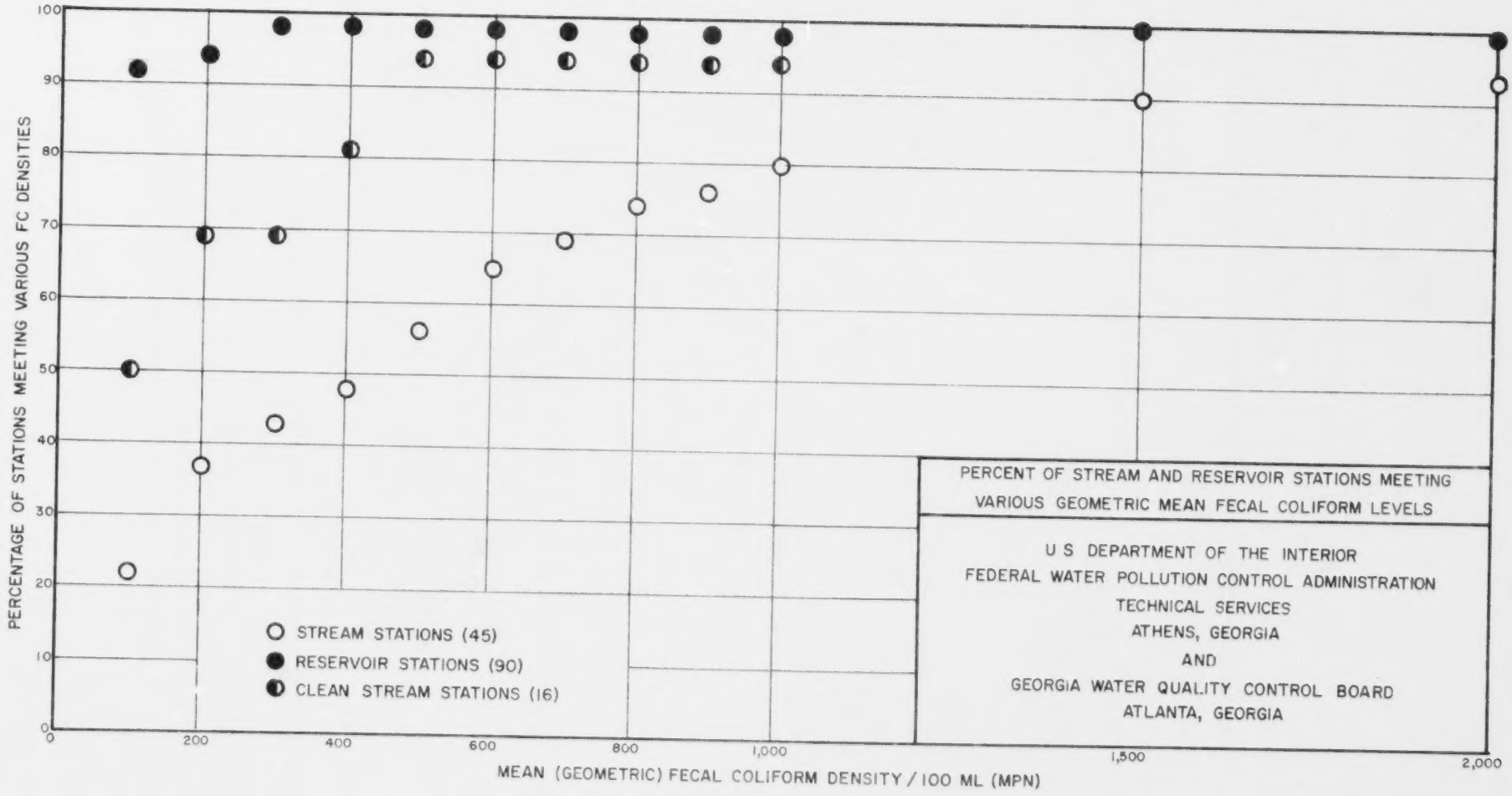
PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN (GEOMETRIC) FECAL COLIFORM DENSITY / 100 ML (MPN)
STREAM STATIONS (45)
RESERVOIR STATIONS (90)
CLEAN STREAM STATIONS (16)
PERCENT OF STREAM AND RESERVOIR STATIONS MEETING
VARIOUS GEOMETRIC MEAN FECAL COLIFORM LEVELS
U S DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
ATHENS, GEORGIA
AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 8

TABLE V

INDIVIDUAL STATIONS THAT WILL NOT MEET VARIOUS
GEOMETRIC MEAN FECAL COLIFORM DENSITIES
AND THE WASTE CLASSIFICATION PERCENTAGES REPRESENTED

STATIONS*	NW	LW	DW	TW
Gm 100/100 ml				
CT-1, CT-1A, CT-2, N-14, N-15, N-16, N-17, N-18, N-18A, N-19, NR-12, T-33, T-32, T-31, T-30, T-29, T-38, T-26, T-27, T-28, 356-22, 17-19, 75-21, 602-20, 255-17, 115-16, S-1759, S-2422, 600-7, 52-4, FC-3, H-4, H-5, H-6, H-7, H-8, 72-9, CCII C-2, C-4, F-3, P-1, P-2	26%	42%	32%	74%
Gm 300/100 ml				
N-14, N-15, N-16, N-17, N-18, N-18A, NR-12, T-33, T-32, T-31, T-30, T-29, T-28, T-38, 17-19, 75-21, 602-20, 255-17, 115-16, S-1759, S-2422, 600-7, FC-3, H-4, H-7, H-8, P-1, P-2	10%	54%	36%	90%
Gm 500/100 ml				
N-15, N-16, N-17, N-18, N-18A, NR-12, T-33, T-32, T-31, T-29, T-28, 17-19, 602-20, 115-16, S-1759, S-2422, 600-7, FC-3, H-4, H-8, P-2	0%	52%	48%	100%

STATIONS*	NW	LW	DW	TW
Gm 200/100 ml				
CT-1A, N-14, N-15, N-16, N-17, N-18, N-18A, N-19, NR-12, T-33, T-32, T-31, T-30, T-29, T-38, T-27, T-28, 17-19, 75-21, 602-20, 255-17, 115-16, S-1759, S-2422, 600-7, 52-4, FC-3, H-4, H-7, H-8, 72-9, C-4, P-1, P-2	15%	44%	41%	85%
Gm 400/100 ml				
N-16, N-17, N-18, N-18A, NR-12, T-33, T-32, T-31, T-30, T-29, T-28, T-38, 17-19, 75-21, 602-20, 255-17, 115-16, S-1759, 600-7, FC-3, H-4, H-8, P-2	9%	56%	35%	91%
Gm 1000/100 ml				
N-16, N-17, N-18, N-18A, NR-12, T-32, 17-19, S-1759, FC-3, P-2	0%	50%	50%	100%

*NW = No Obvious Waste Source Present
LW = Livestock/Wildlife Refuge Waste Present
DW = Domestic Waste Present
TW = Total Percentage of Stations with Wastes Present

A comparison of stream stations and clean stream stations is shown in Figures 7 and 8. These curves show a step-like increase in stations meeting various FC levels. The primary breakpoint for the clean stream stations appears at density levels of 500 and 600/100 ml for the geometric and arithmetic presentations, respectively. At these points, the respective percentage of stations meeting these levels is 94 and 75. A doubling of these levels results in 0 percent and 2 percent of the remaining stations meeting these higher levels.

The difference in stream and reservoir water quality points to the need for separate consideration in any bacterial criteria selection. This separate consideration can be accomplished using separate stream and reservoir criteria. Such an approach might be permissible since about 95 percent of water-contact recreation occurs in reservoirs and coastal waters in Georgia.

COASTAL AREAS

The percentage of coastal stations meeting different mean FC levels are shown in Tables III and IV, and Figure 9. The figure shows breakpoints at mean FC densities of 100 and 300/100 ml for geometric and arithmetic treatments, respectively. At these levels 100 percent and 89 percent of the stations meet the respective FC levels.

SEASONAL INFLUENCES

Recreational season and non-seasonal FC densities for each stream reach are shown in Table VI. A similar comparison for each station is summarized in Appendix G. These data are also shown in Figure 10. These data show a slightly higher percentage of

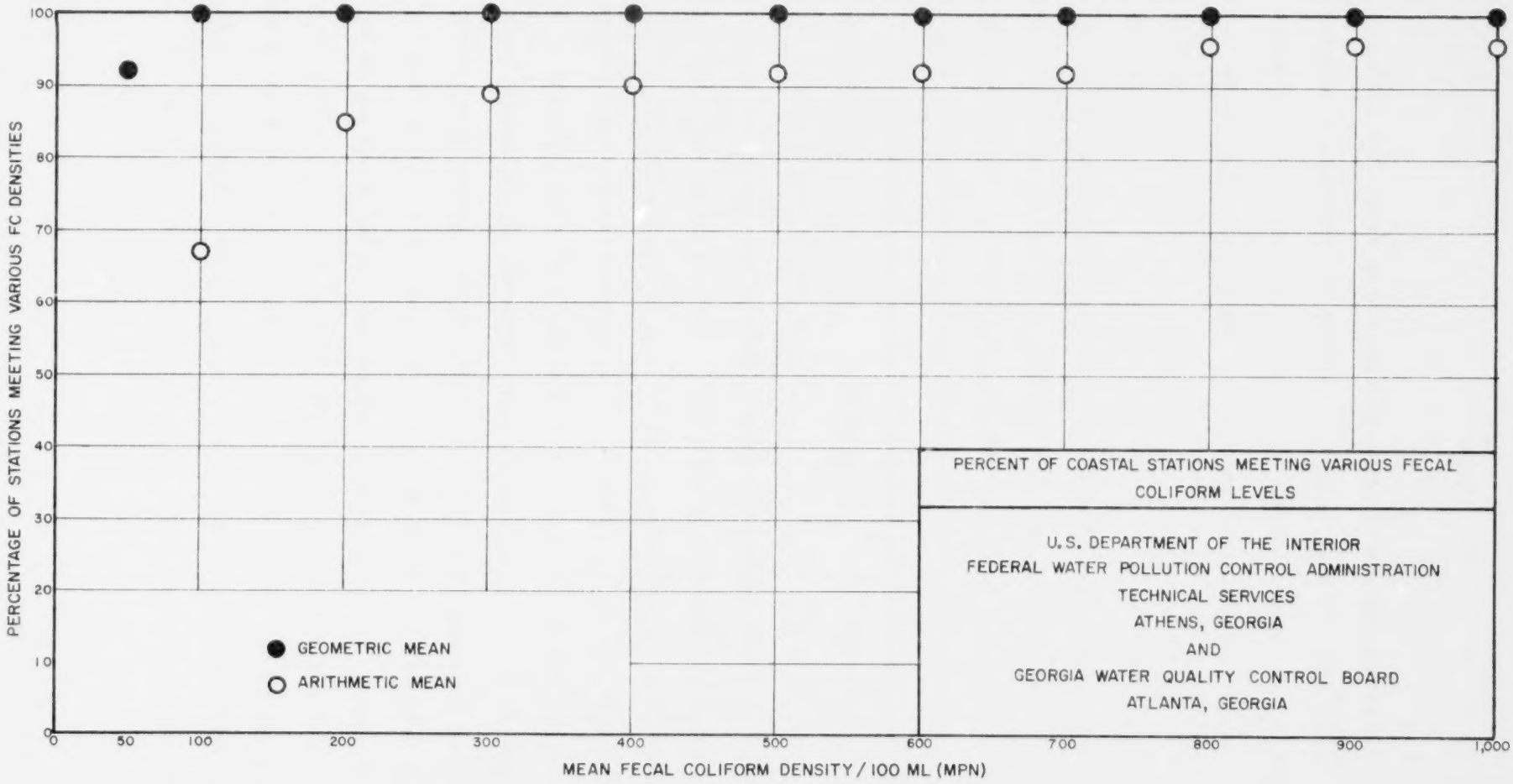
PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
50
100
200
300
400
500
600
700
800
900
1,000
MEAN FECAL COLIFORM DENSITY / 100 ML (MPN)
GEOMETRIC MEAN
ARITHMETIC MEAN
PERCENT OF COASTAL STATIONS MEETING VARIOUS FECAL COLIFORM LEVELS
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
ATHENS, GEORGIA
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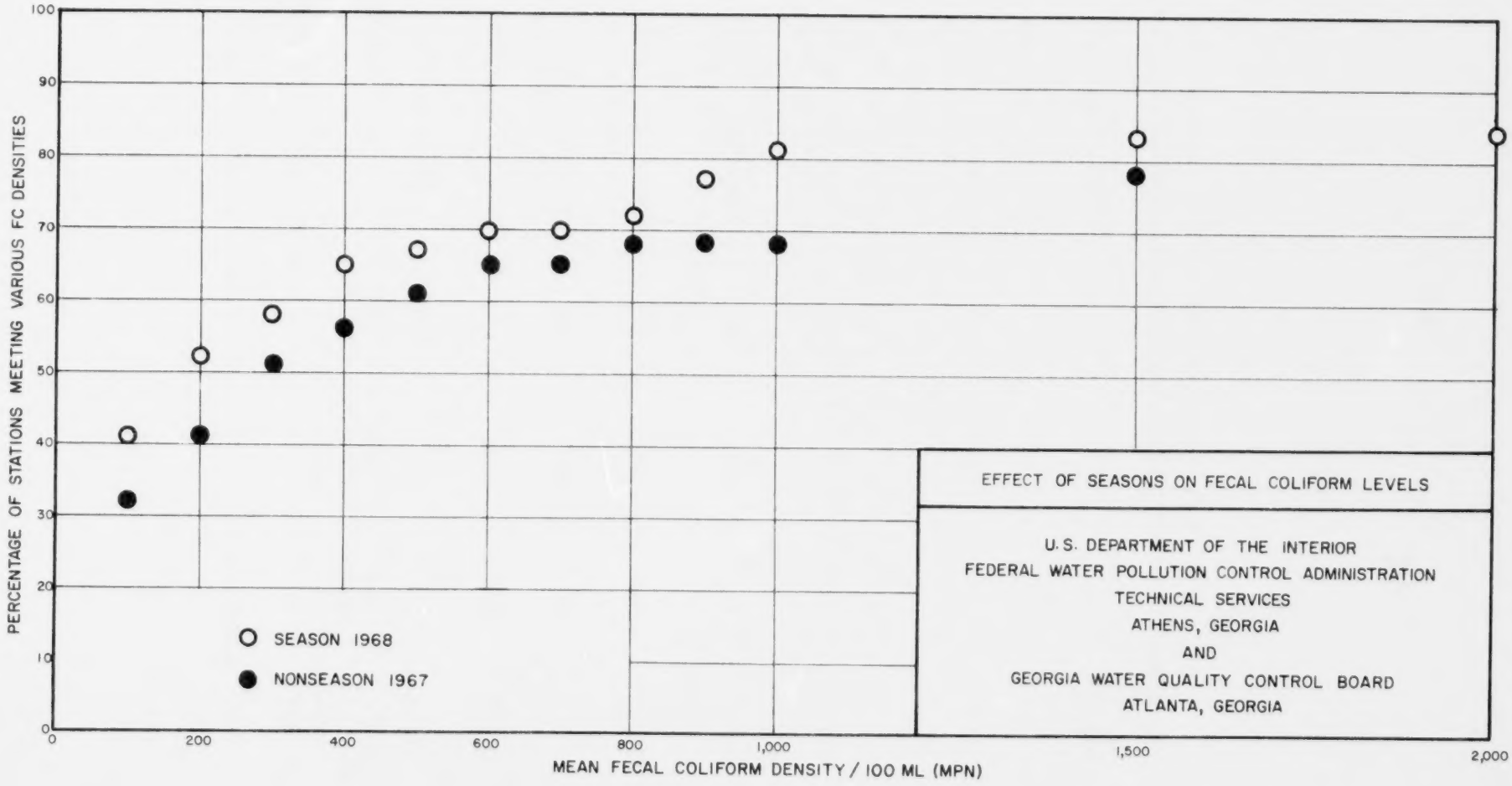
FIGURE 9


PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN FECAL COLIFORM DENSITY / 100 ML (MPN)
SEASON 1968
NONSEASON 1967
EFFECT OF SEASONS ON FECAL COLIFORM LEVELS
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
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AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 10

TABLE VI

EFFECT OF SEASON ON MEAN FECAL COLIFORM DENSITY
FOR EACH STREAM REACH

STREAM REACH	ARITHMETIC MEAN SEASON* 1968	ARITHMETIC MEAN NONSEASON 1967	GEOMETRIC MEAN SEASON 1968	GEOMETRIC MEAN NONSEASON 1967
Chattooga River	390	490	100	230
Nottely River Above Nottely Lake	3300	2000	1225	640
Nottely River Below Nottely Lake	260	190	20	30
Toccoa River Above Blue Ridge Reservoir	890	6240	480	1750
Toccoa River Below Blue Ridge Reservoir	1340	5800	90	700
Chattahoochee River Above Lake Lanier	1220	710	590	630
Lower Chattahoochee River	100	530	-	180
Hiawassee River Above Lake Chatuge	550	520	400	290
Savannah River Below Lake Hartwell	65	-	80	-
Lower Flint River	70	180	-	100

*Recreational Season - Memorial Day to Labor Day

stations meet the various levels during the seasonal period. These data seem to reflect the effect of surface runoff intensity rather than the effect of recreational use. In comparing seasons, the effect of surface runoff must not be confused with recreational effects.

Comparing seasonal and nonseasonal FC densities in the coastal areas show that recreational use had little effect on the observed densities. Rather, tidal effect appears to influence the observed densities to a much greater degree than does either recreational use or season.

EFFECTS OF RUNOFF

Flows were determined at most stream stations during each of the study periods. Based on hydrograph examination, flow was classified into two categories -- stable or peaking. Although this is a crude attempt to categorize runoff, the indicator density difference for the respective categories give the method some merit.

The percentage of stations meeting various FC densities under different flow conditions is shown in Figures 11 and 12. These figures show a greater percentage of stations had lower FC densities during stable flow conditions than during peaking flow conditions illustrating the adverse effect of storm water runoff on water quality. High fecal coliform levels resulting from occasional high runoff should, however, be included in computing means for criteria compliance. Stable flow and peaking flow effects on each stream reach is summarized in Table VII.

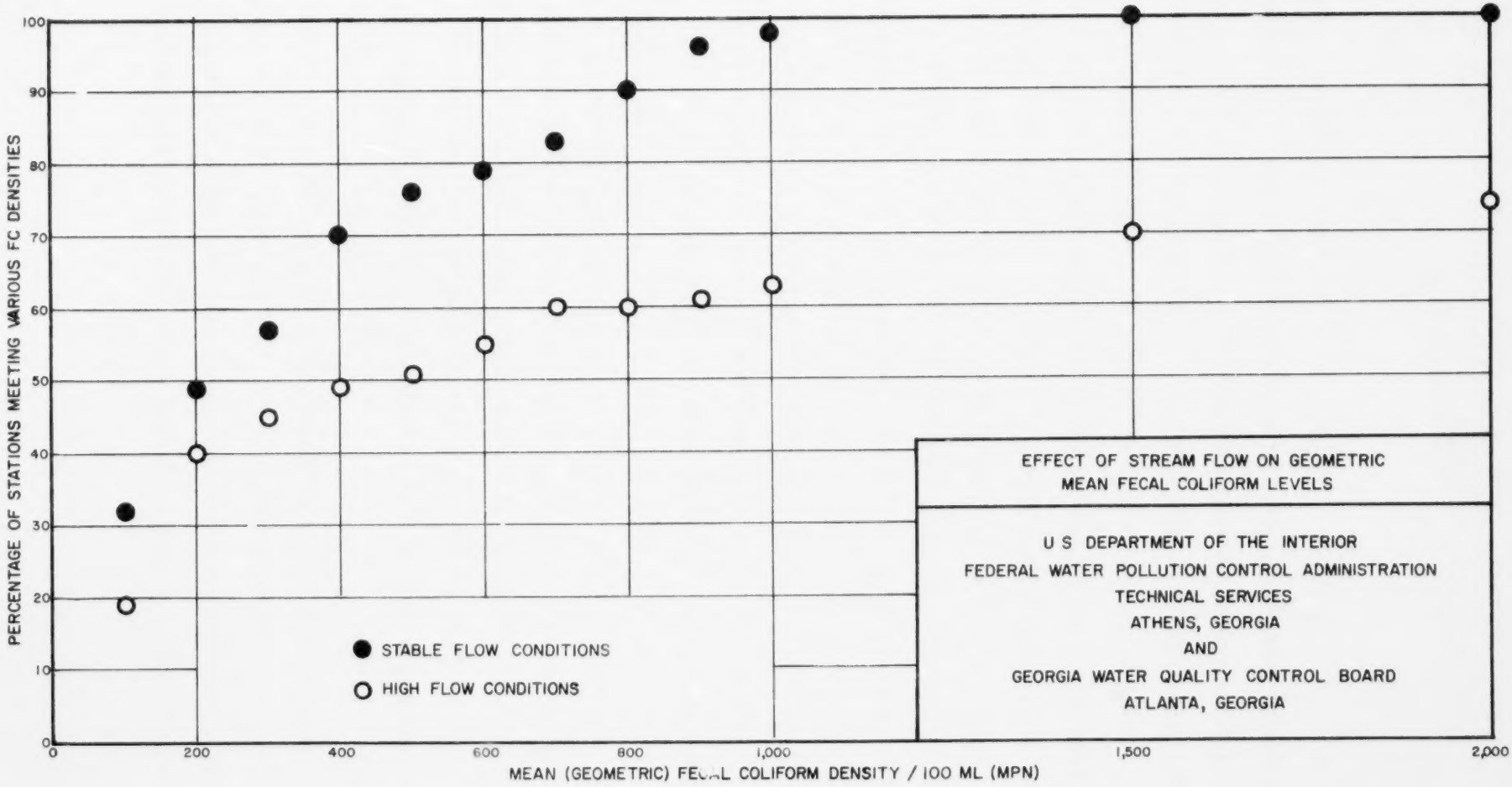
PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN (GEOMETRIC) FECAL COLIFORM DENSITY / 100 ML (MPN)
STABLE FLOW CONDITIONS
HIGH FLOW CONDITIONS
EFFECT OF STREAM FLOW ON GEOMETRIC MEAN FECAL COLIFORM LEVELS
U S DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
TECHNICAL SERVICES
ATHENS, GEORGIA
AND
GEORGIA WATER QUALITY CONTROL BOARD
ATLANTA, GEORGIA

FIGURE 11

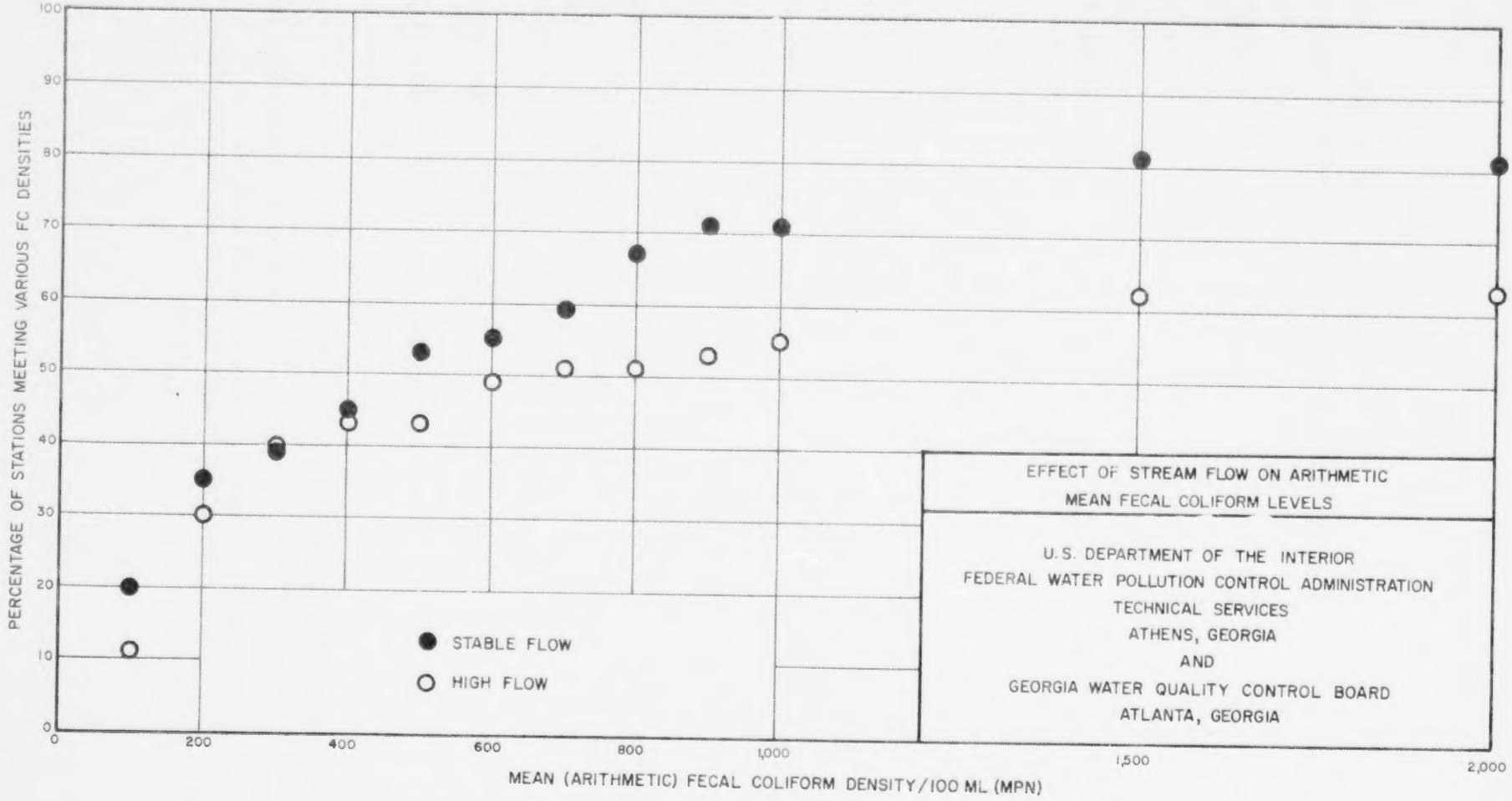
PERCENTAGE OF STATIONS MEETING VARIOUS FC DENSITIES
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1,000
1,500
2,000
MEAN (ARITHMETIC) FECAL COLIFORM DENSITY/100 ML (MPN)
STABLE FLOW
HIGH FLOW
EFFECT OF STREAM FLOW ON ARITHMETIC
MEAN FECAL COLIFORM LEVELS
U.S. DEPARTMENT OF THE INTERIOR
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FIGURE 12

TABLE VII

EFFECT OF SURFACE RUNOFF ON MEAN FC DENSITIES/100 ML
FOR EACH STREAM OR RESERVOIR REACH

	STABLE FLOW CONDITIONS*		PEAKING FLOW CONDITIONS*		ALL FLOW CONDITIONS*	
	$\bar{X}$	Gm	$\bar{X}$	Gm	$\bar{X}$	Gm
NOTTELY RIVER ABOVE NOTTELY LAKE	930	580	6100	990	3900	790
NOTTELY RIVER BELOW NOTTELY LAKE	90	20	340	200	230	80
TOCCOA RIVER ABOVE BLUE RIDGE RESERVOIR	490	310	6400	2900	3000	790
TOCCOA RIVER BELOW BLUE RIDGE RESERVOIR	5100	1500	1600	130	3200	140
HIAWASSEE RIVER ABOVE LAKE CHATUGE	530	300	530	250	530	270
CHATTAHOOCHEE RIVER ABOVE LAKE LANIER	510	305	2700	1300	1100	430
SAVANNAH RIVER BELOW LAKE HARTWELL	60	30	260	100	130	40
CHATOOGA RIVER	130	90	750	150	440	120
NOTTELY RESERVOIR	1100	130	4900	4900	660	60
BLUE RIDGE RESERVOIR	20	10	40	10	10	5
LAKE CHATUGE	-	-	-	-	100	20
LAKE LANIER	-	-	-	-	40	5
HARTWELL RESERVOIR	-	-	-	-	4	2
CLARK HILL RESERVOIR	-	-	-	-	3	2
FLAT CREEK EMBAYMENT	-	-	-	-	200	100
STALKING HEAD CREEK	-	-	-	-	1900	860
GOAT ROCK LAKE	370	115	1200	1200	550	120
LAKE SEMINOLE	-	-	-	-	290	110
LAKE BLACKSHEAR	55	45	190	120	90	60
FLINT RIVER	130	90	250	120	210	110

*Determined by hydrograph examination.

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1. Stevenson, Albert H., "Studies of Bathing Water Quality and Health," American Journal of Public Health, 43, pp 529-538 (May 1953).

2. American Public Health Association, Standard Methods for the Examination of Water and Wastewater, Twelfth Edition, 1965.

3. Geldreich, E. E., Clark, H. F. Huff, C. B., and Best, L. C., "Fecal Coliform Organism Medium for Membrane Filter Techniques," Journal AWWA, 57, No. 2 (February 1965).

APPENDIX A

LETTER FROM SECRETARY UDALL

July 18, 1967

Dear Governor Maddox:

I am pleased to inform you that we have completed our review of the water quality criteria and implementation plan submitted by the State of Georgia for its interstate waters, and I am approving these criteria and plans as Federal standards under the Federal Water Pollution Control Act, as amended. Your State is to be commended on the development of effective water quality standards.

We are concerned about the bacteriological criteria adopted by Georgia for public water supply, recreational, and other uses. However, we have been assured by the State Water Quality Control Board that these criteria will be reviewed by the State, working with the Federal Water Pollution Control Administration Regional Office in Atlanta. We have further been assured that, should this review indicate that more stringent bacteriological criteria are necessary, the present criteria will be modified accordingly. It is with this understanding that I am prepared to approve Georgia's water quality criteria at this time.

Successful implementation of the program set forth in these standards should achieve our mutual goals of protecting and enhancing the quality and productivity of Georgia's interstate waters. The staff of the Federal Water Pollution Control Administration will be in touch with your water pollution control staff concerning ways in which we can cooperate in carrying out the objectives of this program.

Once again, I wish to congratulate you on a job well done.

Sincerely yours,

Stewart L. Udall

Secretary of the Interior

Honorable Lester Maddox
Governor of Georgia
Atlanta, Georgia 30334

RWHanmer:ms - PFW - 7/14/67

cc: Secretary's files
Secretary's Reading Files
Asst. Secretary for WPC
Dr. Hirsch, PP&D
Regional Director, Southeast Region
State Water Quality Control Board (Georgia)
Commissioner, Deputy Commissioner
C. Pierce, OPI

APPENDIX B

LIST OF FRESHWATER SAMPLE STATION LOCATIONS AND DESCRIPTIONS

CHATTOOGA RIVER

Station Number	Description
CT-1	Ga. 28 bridge over Chattooga River.
CT-2	Approximately 2 miles downstream of Ga. 29 bridge over Chattooga River at point where Ga. 28 turn from NE- SW downstream to a NW-SW direction.
CT-3	Ga. 2 bridge over Chattooga River
CT-1A	Approximately ½ Mile downstream of Ga. 28 just below the confluence of North Fork Chattooga and West Fork Chattooga Rivers.

NOTTELY RIVER AND NOTTELY RESERVOIR

Station Number	Description
N-13	Dirt road over Nottely River near its junction with Richard B. Russell Scenic Hwy. (Ga. 348) just south of Harmony Church.
N-14	Ga. 180 bridge (dirt road) over Nottely River upstream of its junction with Stink Creek.
N-15	Ga. 11 and US 19 bridge over Nottely River near County Road S-975.
N-16	Dirt road bridge over Nottely River near dirt road's junction with Ga. 19 approximately 2 miles south of Ga. Mtn. State Experiment Station.
N-17	Dirt road bridge over Nottely River just off Ga. 19 near junction of Morgan Branch and Nottely River.
NR-18	Ga. 2 bridge over Nottely Reservoir.
NR-18A	Just downstream of junction of Butternut Creek and Nottely Reservoir.
NR-19	Paved County Road bridge over Nottely Reservoir just downstream from its junction with Welborn Branch.
NR-20	Paved County Road bridge over Odum Creek arm of Nottely Reservoir near Providence Church.
NR-21	Immediately downstream of Nottely Dam on Nottely River.
N-22	Smith Bridge of County Road S-1005 over Nottely River.
N-10*	Bridge over Wolf Creek on State Road S-975.
N-11*	Bridge over Butternut Creek on Ga. 11.
N-12*	Bridge over Nottely Reservoir on Ga. 11.

TOCCOA RIVER AND BLUE RIDGE RESERVOIR

Station Number	Description
T-28	Ga. 5 bridge over Toccoa River in McCaysville, Ga.
T-27	Toccoa River at Copperhill Recreation Center
T-26	County Road S-2332 bridge over Toccoa River.
T-25	County Road (running SW out of Mineral Bluff) bridge over Toccoa River.
BR-24	Immediately downstream from Blue Ridge Dam.
BR-34	First road to left when heading south on US 76 from Blue Ridge Dam.
BR-35	First road (dirt) on right when heading east on US 76 from its intersection with Ga. 60.
BR-23	Morgantown Point Recreation area.
T-29	County Road S-1010 bridge over Toccoa River.
T-30	Rock Creek Road Bridge over Toccoa River.
T-31	County Road bridge over Toccoa River near Fannin County and Union County line.
T-32	County Road bridge over Toccoa River turning right off Ga. 60 near Gaddistown.
T-33	County Road bridge over Toccoa River just upstream from river's junction with Gilreath Creek and William's Creek.
T-34*	Bridge over Suches Creek Ga. 60.
T-35*	Bridge over Canada Creek, Ga. 60.
T-36*	Bridge over Mineral Springs Creek approximately 1 mi. before it enters the Toccoa River
T-37*	Young Stone Creek, approximately 3/4 mi. before it enters the Toccoa River.
T-38	Shallowford Bridge over Toccoa River
T-39*	Bridge over Dry Creek, Near Murphy junction.

UPPER CHATTAHOOCHEE RIVER

Station Number	Description
75-25*	Small creek flaring out of Unicoi State Park. Sample 10-15 yards upstream from Ga. 75.
75-24*	Spoilcane Creek just above junction with Chattahoochee River.
75-23	Chattahoochee River just above junction with Spoilcane Creek.
356-22	Ga. 356 bridge over Chattahoochee River near intersection of Ga. 356 with Ga. 17.
75-21	Ga. 75 bridge over Chattahoochee River near intersection of Ga. 17
602-20	Chattahoochee River just upstream of its junction with Sautee Creek.
602-19*	Sautee Creek just upstream of junction with Chattahoochee River.
17-18*	Ga. 17 bridge over Mauldin Creek (county line between Habersham County and White County.)
255-17	Ga. 255 bridge over Chattahoochee River (county line between Habersham County and White County.)
115-16	Ga. 115 bridge over Chattahoochee River (count line between Habersham County and White County.)
S-1759-15	County Road S-1759 bridge over Chattahoochee River near View community (County line between Habersham County and White County)
S-2422-14	County Road S-2422 dead ends at Chattahoochee River in Habersham County just upstream of intersection of Habersham County, White County, and Hall County.
S-1349*	Soquee River at Hwy bridge 105, Habersham County.
17-19	Ga. 17 bridge over Chattahoochee River at Helen Ga.

LAKE LANIER

Station Number	Description
600-7	Belton bridge over upper extremity of Chattahoochee River arm of Lake Lanier in Hall County.
129-6	Ga. 11 and US 129 bridge over Chattahoochee River arm of Lake Lanier just upstream of its junction with the Little River arm of Lake Lanier in Hall County.
284-5	Ga. 284 bridge over Chattahoochee River arm of Lake Lanier in Hall County.
52-4	Ga. 52 bridge (Lula Bridge) over Chattahoochee River arm of Lake Lanier in Hall County.
60-3	Ga. 60 bridge over Lake Lanier just downstream of the junction of Little River and Chattahoochee River in Hall County
53-2	Ga. 53 bridge over Lake Lanier near Gainesville Marina in Hall County.
141-1	Ga. 141 bridge over Lake Lanier in vicinity of Chestatee Bay near Hall County and Forsyth County line.
Marinas	See attached maps
FC-1	Mouth of Flat Creek Bay, approximately 1 mile from mouth of Flat Creek.
FC-3	The point at which the flowing water of Flat Creek meets the still water at Flat Creek.

HIAWASSEE RIVER AND LAKE CHATUGE

Station Number	Description
H-4	Ga. 2 and U. S. 76 bridge over Hiawassee River.
H-5	Ga. 17 and Ga. 75 bridge over Hiawassee River near intersection with Ga. 66.
H-6	Ga. 17 and Ga. 75 bridge over Hiawassee River near Mt. Zion Church.
H-7	County Road bridge over Hiawassee River near intersection of river and Owl Creek.
H-8	Ga. 17 and Ga. 75 bridge over Hiawassee River near Calvary Church and just south of intersection of this road with Ga. 2 and U. S. 76.
LC-9	Ga. 17, 2, 75 and US 76 bridge over Chatuge Lake by the Macedonia Church just north of intersection of Ga. 17 and Ga. 75 with Ga. 2 and U. S. 76.
LC-10	US 76 bridge over bay formed by Chatuge Lake and Shake Rag Branch.
LC-11	US 76 bridge over Chatuge Lake immediately outside of Hiawassee on northwest side of town.
LC-12	Point where County Road S-1707 dead ends into Chatuge Lake at end of large point northwest of Hiawassee.
H-9*	Soapstone Creek approximately 100 meters upstream from its confluence with the Hiawassee River.
H-10*	Hightower Creek at bridge approximately 700 meters upstream from its confluence with the Hiawassee River.

SAVANNAH BELOW HARTWELL

Station Number	Description
601-8	Dirt road which dead ends at Savannah River turns East off Bobby Brown State Park road at Tater' Grove Church in Elbert County, Ga.
72-9	Ga. 72 bridge over Savannah River in Elbert County.
82-10	Ga. 82 bridge over Savannah River in Elbert County.
181-11	Ga. 181 bridge over Savannah River in Elbert County.
29-12	Ga. 29 bridge over Savannah River in sight of Hartwell Reservoir in Elbert County.
HD-13	Immediately below Hartwell Dam in Savannah River in Elbert County.
BGC*	Big Generostee Creek immediately before its confluence with the Savannah River.
BDC*	Beaverdam Creek approximately 1½ mile before its' confluence with the Savannah River.
CC*	Cedar Creek approximately ¼ mile before its' confluence with the Savannah River.

* - Streams contributing waste but not classified as recreational streams.

CLARK HILL RESERVOIR

Station Number	Description
CH-1	Pistol Creek arm of Clark Hill Reservoir near shoreline mileage marker 637.
CH-2	Newford Creek arm of Clark Hill Reservoir near shoreline mileage marker 621.
CH-3	Junction of Pistol Creek and Newford Creek near shoreline mileage marker 628.
CH-4	Junction of Pistol Creek, Newford Creek and Broad River near shoreline mileage marker 615.
CH-5	Shoreling mileage marker 713 in Savannah River arm of Clark Hill Reservoir.
CH-6	Junction of Fishing Creek and Savannah River near shoreline mileage marker 607.
CH-7	Savannah River arm of Clark Hill Reservoir near shoreline mileage marker 704.
CH-8	Junction of Russell Creek and Savannah River near shoreline mileage marker 694.
CH-9	Savannah River arm of Clark Hill Reservoir near shoreline mileage marker 676.
CH-10	Broad River arm of Clark Hill Reservoir near shoreline mileage marker 669.
CH-11	Broad River arm of Clark Hill Reservoir near shoreline mileage marker 647.
CH-12	Ga. 79 birdge over Broad River arm of Clark Hill Reservoir.
CH-13	Savannah River arm of Clark Hill Reservoir near shoreline mileage marker 522.
CH-14	US 378 Bridge over Clark Hill Reservoir.
CH-15	US 378 bridge over Little River, South Carolina.
CH-16	Little River near shoreline mileage marker 890.
CH-17	Savannah River near shoreline mileage marker 916.
CH-18	Junction of Little River (S. C.) and Savannah River.
CH-19	Junction of Soap Creek and Savannah River.

Clark Hill Reservoir continued

Station Number	Description
CH-20	Soap Creek near shoreline mileage marker 468
CH-21	County Road over Soap Creek near its junction with Dry Fork Creek.
CH-22	Dry Fork Creek near shoreline mileage marker 477.
CH-23	US 378 bridge over Soap Creek.
CH-24	Soap Creek near shoreline mileage marker 496.

LOWER HARTWELL RESERVOIR

Station Number	Description
HR-1	Public boat launching area in Watsadler Creek arm of Hartwell Reservoir near Ga. 181 and US 29 on Georgia side of Lake.
HR-2	Public boat launching area on southside of Long Point in Hartwell Reservoir. This area faces the bay formed by Powder Bog Creek on Georgia side of Lake.
HR-3	Public boat launching area located at Carter's Ferry in Hartwell Reservoir. This area faces the bay formed by Little Lightwood Log Creek, Flat Shoals Creek, and Gun Branch Creek on the Georgia side of the Lake.
HR-4	Public boat launching area located at Island Point near intersection of South Carolina 187 and US 29 on South Carolina side of Lake.
HR-5	Public boat launching area located at Hartwell Dam Recreational area South Carolina. This area just upstream from Hartwell Dam.
HR-6	Ga. 181 and US 29 bridge over arm of Hartwell Reservoir just west of the town of Hartwell.
HR-7	Near shoreline mileage marker 59 on arm of Hartwell Reservoir Northwest of the town of Hartwell.
HR-8	Ga. 51 bridge over Flat Shoals Creek arm of Hartwell Reservoir.
HR-9	Public boat launching area of Hartwell Marina just north of the town of Hartwell.
HR-10	Channel buoy LLC-6 just east of Hart County Park on Little Lighwood Log Creek.
HR-11	Near shoreline mileage marker 86 and channel marker buoy LLC-4 on Little Lightwood Log Creek.
HR-12	Channel marker buoy LLC-1-GB midway between Carter's Ferry and Long Point.
HR-13	Samll bay on south side of Sadlers Creek State Park, South Carolina.

UPPER HARTWELL RESERVOIR

Station Number	Description
HR-14	Brookhaven Circle Road bridge over arm of Hartwell Reservoir.
HR-15	Narrow part of Eastanollee Creek just upstream from shoreline mileage marker 266.
HR-16	Channel marker EC 3 in Eastanollee Creek near Stephen Co. and Franklin County line.
HR-17	Channel marker EC 2 in Eastanollee Creek arm of Hartwell Reservoir.
HR-18	Channel marker T-75-EC at junction of Eastanollee Creek and Tugaloo River.
HR-19	Channel marker T-77 in Tugaloo River arm of Hartwell Reservoir.
HR-20	Channel marker T-78 in Tugaloo River arm of Hartwell Reservoir.
HR-21	Channel marker T-80 in Tugaloo River arm of Hartwell Reservoir.
HR-22	Channel marker T-73 at junction of Tugaloo River and Choestoea Creek.
HR-23	Channel marker CHC 2 in Choestoea Creek arm of Hartwell Reservoir just above its junction with Tugaloo River.
HR-24	Channel marker T-69 in Tugaloo River arm near shoreline mileage marker 254 of Hartwell Reservoir.
HR-25	Channel marker T-65 in Tugaloo River arm of Hartwell Reservoir near Shelors Branch.

LOWER CHATTAHOOCHEE RIVER

Station Number	Description
CC-I	Bartletts Ferry Dam - just upstream of Dam, River mile 177.4
CC-II	Bartletts Ferry Dam - just downstream of Dam, River mile 177.4
CC-III	Lake Oliver - City of Columbus waterworks intake - River mile 163.2
C-1	Lake Semcnole, Booster Club boat dock at launcing ramp.
C-2	Georgia highway 91 bridge
C-4	Georgia highway 62 bridge
C-5	U. S. highway 82 bridge

LOWER FLINT RIVER

Station Number	Description
F-1	Georgia Highway 257, Lake Blackshear
F-2	U. S. Highway 280, Lake Blackshear
F-3	Kinchajoonee Creek, Georgia Highway 91, Lake Worth.
F-4	Chehaw State Park, dock at launch ramp, Lake Worth.
F-20	Georgia Highway 27
F-21	Lake Blackshear-middle
F-22	U. S. Highway 280
F-23	Georgia Highway 32
F-25	Lake Worth-middle

PIEDMONT WILDLIFE REFUGE

Station Number	Description
P-1	Just outside the refuge on Stalking Head Creek.
P-2	First road crossing Stalking Head Creek outside the Refuge, up stream from station 1.

APPENDIX C

LIST OF COASTAL SAMPLING STATIONS

LIST OF COASTAL SAMPLE STATION LOCATIONS AND DESCRIPTIONS

Station Number	Description
3	Savannah Beach at Highway 80 & Butler Avenue
4	Savannah Beach at End of 17th Street
5	Savannah Beach at Tybee Creek - Public Boat Dock
102	Big Ogeechee River at U. S. Highway #17 bridge
15	Little Ogeechee River at Forest River & Coffee Bluff
16	Vernon River at Rose Dhu Road - Mosher's Boat Dock
29	Vernon River at Beaulieu Avenue
30	Vernon River at Burnside River * A. W. Salter's residence (Rio Vista)
31	Vernon River at Back (Moon) River & Wesley Gardens
32	Vernon River at Shipyard Creek - End of Strong Road & Pin Point
34	Wilmington River at Skidaway River - Wymberly Yacht Club
35	Wilmington River at Herb River - Bob Taylor's Fishing Camp
41	Wilmington River at Savannah Yacht and Country Club - Bradley's Point
43	Wilmington River at South end of Island & Savannah Gas Company
44	Half Moon River at Green's Boat Dock
J-1 - J-6	Jekyll Island
S-1 - S-6	Saint Simon's Island

APPENDIX D

WASTE CLASSIFICATION OF THE INDIVIDUAL STATIONS

STATION CLASSIFICATION BASED ON WASTE SURVEY DATA

STREAM OR RESERVOIR	STATIONS WITH NO OBVIOUS WASTE PRESENT	STATIONS WITH LIVESTOCK WASTE PRESENT	STATIONS WITH DOMESTIC WASTE PRESENT
Hiawassee River & Lake Chatuge	LC-10, LC-11, LC-12	H-5, H-6, H-7, H-8	H-4, LC-9
Chatooga River	CT-1, CT-2, CT-3	---	CT-1A
Savannah River, below Lake Hartwell	HD-13, 29-12, 82-10, 601-8	---	181-11, 72-9
Hartwell Reservoir	HR-1, HR-2, HR-3, HR-4, HR-5, HR-6, HR-7, HR-8, HR-9, HR-10, HR-11, HR-13, HR-14, HR-19, HR-20, HR-21, HR-22, HR-23, HR-24, HR-25	---	HR-12, HR-15 HR-16, HR-17 HR-18
Toccoa River & Blue Ridge Reservoir	T-30, T-38, BR-23, BR-24, BR-34, BR-35	T-31, T-32, T-33, T-25, T-29	T-26, T-27, T-28
Chattahoochee River & Lake Lanier	75-23, 356-22, 129-6, 284-5, 60-3, 52-4, 53-2, 141-1 BR-1, BR-2, BR-3, BR-4, BR-5, H-1, H-2, H-3, H-4, H-5, H-6	602-20, 75-21 115-16, 255-17	600-7, 17-19, S1759, S2422 FC-1, FC-3
Nottely River & Nottely Reservoir	N-13, N-14, NR-20, NR-21, NR-22	N-15, N-16, N-17, N-18, N-18A, N-12	N-15, N-16, N18A, N-19
Clark Hill Reservoir	CH-1, CH-2, CH-3 CH-4, CH-5, CH-6, CH-7, CH-8, CH-9, CH-10, CH-11, CH-12, CH-13, CH-14, CH-15, CH-16, CH-17, CH-18, CH-19, CH-20, CH-21, CH-22, CH-23, CH-24	---	---

STATION CLASSIFICATION BASED ON WASTE SURVEY DATA

Cond.

STREAM OR RESERVOIR	STATION WITH NO OBVIOUS WASTE PRESENT	STATIONS WITH LIVESTOCK WASTE PRESENT	STATIONS WITH DOMESTIC WASTE PRESENT
Lower Chattahoochee River	CC-I, CC-II, CC-III, C-1, C-2, C-4, C-5	---	---
Lower Flint River	F-1, F-2, F-3, F-4	---	---
Piedmont Wildlife Refuge	P-1, P-2	---	---

APPENDIX E

SUMMARY OF STATION DATA - MPN

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Chattooga River	CT-1	170	110	79	540	33	8
	CT-1A	1400	250	104	5400	70	4
	CT-2	540	130	185	3500	23	8
	CT-3	120	80	90	240	13	8
Nottely River and Nottely Reservoir	N-13	110	60	57	540	17	8
	N-14	400	310	260	920	130	8
	N-15	1700	630	320	5400	130	8
	N-16	3400	1400	1200	13000	240	8
	N-17	6000	1700	1200	24000	200	8
	N-18	6500	1100	1110	35000	130	6
	N-18A	11100	3400	3300	35000	330	5
	NR-19	1700	230	260	4900	13	6
	NR-12	1300	1300	1300	1400	1100	3
	NR-20	30	10	26	49	2	6
	NR-21	20	20	20	49	5	7
	NR-22	230	80	230	540	2	7
Toccoa River and Blue Ridge Reservoir	T-33	4900	790	230	16000	110	7
	T-32	4200	1400	1300	16000	130	7
	T-31	3600	980	1100	1600	23	7
	T-30	1600	440	330	9200	79	7
	T-29	1800	950	1040	4900	170	6
	T-28	580	460	395	1300	230	4

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Toccoa River and Blue Ridge Reservoir	BR-23	10	4	2	23	2	7
	BR-35	5	3	2	13	2	6
	BR-34	10	8	7	33	2	6
	BR-24	30	8	2	130	2	7
	T-25	3500	20	7	24000	2	7
	T-26	3500	110	49	24000	23	7
	T-27	2400	210	130	16000	50	7
	T-28	2700	530	1600	16000	3	7
Chattahoochee River and Lake Lanier	75-23	190	70	79	920	3	7
	356-22	180	130	150	490	32	7
	17-19	2600	1300	1100	7900	460	4
	75-21	570	480	450	1100	210	7
	602-20	980	820	1000	1600	350	3
	255-17	810	440	490	3300	130	7
	115-16	1500	540	470	7900	110	7
	S-1759	2300	1300	1300	7900	170	7
	S2422	980	710	920	2200	130	7
	600-7	620	620	620	620	620	1
	52-4	230	220	230	260	190	2
	284	3	3	3	5	2	2
	129-6	2	2	2	2	2	2
	60-3	2	2	2	2	2	2
	53-2	2	2	2	2	2	2
	141-1	6	6	6	7	5	2

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Chattahoochee River and Lake Lanier	FC1	205	76	36	930	30	14
	FC3	80,502	11,500	7,500	430,000	930	13
	BR1	163	21	23	2,300	3	21
	BR2	1,488	33	23	15,000	3	20
	BR3	568	59	84	9,300	3	20
	BR4	327	42	43	2,300	3	20
	BR5	42	11	3.6	430	3	19
	H1	136	26	27	930	3	14
	H2	335	65	69	2,300	3	14
	H3	163	27	36	930	3	15
	H4	87	16	19	930	3	14
	H5	74	25	15	430	3	15
	H6	12	7	3.6	43	3	7
Hiawassee River and Lake Chatuge	H-5	200	130	140	700	20	8
	H-6	150	110	130	350	33	8
	H-7	550	370	500	1300	80	8
	H-8	880	550	560	2300	130	8
	H-4	850	510	490	3500	130	8
	LC-9	290	80	40	1600	20	8
	LC-10	90	60	64	330	23	8
	LC-11	20	10	10	80	2	8
	LC-12	10	4	2	50	2	8

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

Contd.

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Clark Hill Reservoir	CH-17	2	2	2	2	2	2
	CH-18	2	2	2	2	2	2
	CH-19	2	2	2	2	2	2
	CH-20	2	2	2	2	2	2
	CH-21	2	2	2	2	2	2
	CH-22	2	2	2	2	2	2
	CH-23	2	2	2	2	2	2
	CH-24	2	2	2	2	2	2
Hartwell Reservoir	HR-1	2	2	2	2	2	2
	HR-2	2	2	2	2	2	2
	HR-3	2	2	2	2	2	2
	HR-4	2	2	2	2	2	2
	HR-5	2	2	2	2	2	2
	HR-6	10	8	10	8	7	2
	HR-7	5	4	5	7	2	2
	HR-8	2	2	2	2	2	2
	HR-9	2	2	2	2	2	2
	HR-10	2	2	2	2	2	2
	HR-11	2	2	2	2	2	2
	HR-12	2	2	2	2	2	2
	HR-13	2	2	2	2	2	2
	HR-14	60	60	60	79	49	2
	HR-15	2	2	2	2	2	2
	HR-16	2	2	2	2	2	2

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

Contd.

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Hartwell Reservoir	HR-17	2	2	2	2	2	2
	HR-18	2	2	2	2	2	2
	HR-19	2	2	2	2	2	2
	HR-20	2	2	2	2	2	2
	HR-21	2	2	2	2	2	2
	HR-22	2	2	2	2	2	2
	HR-23	2	2	2	2	2	2
	HR-24	2	2	2	2	2	2
	HR-25	2	2	2	2	2	2

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

Contd.

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Savannah River Below Hartwell Reservoir	HD-13	10	6	3	49	2	4
	29-12	20	10	8	99	5	7
	181-11	230	60	43	1100	3	7
	82-10	80	40	28	390	23	7
	72-9	310	240	230	730	41	7
	600-8	80	60	71	140	23	6
Clark Hill Reservoir	CH-1	3	3	3	5	2	2
	CH-2	2	2	2	2	2	2
	CH-3	2	2	2	2	2	2
	CH-4	2	2	2	2	2	2
	CH-5	2	2	2	2	2	2
	CH-6	2	2	2	2	2	2
	CH-7	2	2	2	2	2	2
	CH-8	10	6	10	17	2	2
	CH-9	10	10	10	13	11	2
	CH-10	2	2	2	2	2	2
	CH-11	6	6	6	7	5	2
	CH-12	10	7	10	23	2	2
	CH-13	2	2	2	2	2	2
	CH-14	2	2	2	2	2	2
	CH-15	2	2	2	2	2	2
	CH-16	2	2	2	2	2	2

MPN DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Lower Chattahoochee River	CCI	337	62	30	2,300	30	10
	CCII	431	200	101	2,300	30	10
	CCIII	100	81	30	4,300	30	10
	C1	57	44	30	230	30	12
	C2	372	200	220	2,300	30	12
	C4	287	230	205	750	150	12
	C5	1,316	68	63	9,300	30	12
Lower Flint River	F1	96	66	33	390	30	12
	F2	80	51	36	390	30	12
	F3	251	170	150	930	73	10
	F4	182	90	36	930	30	9
	F-20	340	220	310	1,300	30	14
	F-21	21	20	20	33	20	14
	F-22	20	20	20	20	20	14
	F-23	23	20	20	390	20	14
	F-24	34	26	20	140	20	10
	F-25	45	37	20	90	20	11
Piedmont Wildlife Refuge	P-1	1,214	400	390	7,500	30	15
	P-2	2,621	1,500	2,300	9,300	210	14

APPENDIX F

SUMMARY OF STATION DATA - MF

MF DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Chatooga River	CT-1	90	70	80	220	10	8
	CT-1A	550	160	80	2000	60	4
	CT-2	290	110	100	1600	20	8
	CT-3	90	60	70	220	12	8
Nottely River and Nottely Reservoir	N-13	100	80	90	180	18	8
	N-14	170	130	110	470	50	8
	N-15	870	450	260	3500	140	8
	N-16	1800	730	460	9500	190	8
	N-17	1100	590	450	5000	170	8
	N-18	4200	1000	1200	21000	120	6
	N-18A	2400	1300	1300	5000	180	5
	N-19	930	130	330	2500	2	6
	N-12	970	890	780	1700	600	4
	N-20	8	6	7	18	2	6
	N-21	18	10	10	44	2	7
	N-22	150	50	160	470	4	7
Toccoa River and Blue Ridge Reservoir	T-33	770	350	300	3200	70	6
	T-32	820	580	660	1700	60	7
	T-31	630	460	700	960	40	7
	T-30	550	350	580	1300	40	7
	T-29	660	410	500	1700	48	6
	T-38	290	270	230	500	200	4

MF DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Toccoa River and Blue Ridge Reservoir	BR-23	70	5	3	46	2	7
	BR-35	10	10	4	50	2	6
	BR-34	80	10	9	400	2	6
	BR-24	130	10	6	800	2	7
	T-25	200	20	13	1300	4	7
	T-26	280	50	36	1300	3	7
	T-27	50	40	60	88	10	7
	T-28	1300	120	190	4900	4	7
Chattahoochee River and Lake Lanier	75-23	30	20	18	90	8	7
	356-22	70	60	80	120	17	7
	17-19	1300	750	1100	2800	100	4
	75-21	400	290	390	820	65	7
	602-20	240	230	280	300	150	3
	255-17	450	300	260	1300	90	7
	115-16	560	260	300	2700	73	7
	S-1759	700	500	510	1500	80	7
	S-2422	580	370	360	1900	40	7
	600-7	250	250	250	250	250	1
	52-4	170	140	170	270	70	2
	284-5	3	3	3	3	3	2
	129-6	3	3	3	5	1	2
	60-3	3	2	3	3	2	2
	53-2	3	2	3	3	2	2
	141-1	4	2	4	5	2	2

MF DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Hartwell Reservoir	HR-9	1	1	1	1	1	2
	HR-10	1	1	1	1	1	2
	HR-11	1	1	1	1	1	2
	HR-12	1	1	1	1	1	2
	HR-13	1	1	1	1	1	2
	HR-14	3	3	3	4	2	2
	HR-15	2	1	2	2	1	2
	HR-16	2	1	2	2	1	2
	HR-17	2	1	2	2	1	2
	HR-18	2	1	2	2	1	2
	HR-19	2	1	2	2	1	2
	HR-20	2	1	2	2	1	2
	HR-21	2	1	2	2	1	2
	HR-22	2	1	2	2	1	2
	HR-23	2	1	2	2	1	2
	HR-24	2	1	2	2	1	2
	HR-25	2	1	2	2	1	2

MF DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Hiawassee and Lake Chatuge	H-5	140	80	170	320	8	8
	H-6	130	110	100	330	60	8
	H-7	560	440	360	1700	60	8
	H-8	610	390	560	2100	180	8
	H-4	510	380	370	1600	180	8
	LC-9	290	120	200	780	10	8
	LC-10	100	40	23	550	10	8
	LC-11	20	10	11	60	2	8
	LC-12	10	6	5	48	2	8
	HD-13	3	2	2	7	2	4
Savannah River	29-12	10	10	7	25	4	7
	181-11	180	50	74	870	3	7
	82-10	20	20	13	90	10	7
	72-9	260	160	160	1000	30	7
	600-8	90	60	80	260	20	6
Clark Hill Reservoir	CH-1	2	2	2	2	2	2
	CH-2	2	2	2	2	2	2
	CH-3	2	2	2	2	2	2
	CH-4	2	2	2	2	2	2
	CH-5	2	2	2	2	2	2
	CH-6	2	2	2	2	2	2
	CH-7	2	2	2	2	2	2
	CH-8	2	2	2	2	2	2

MF DATA - FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Clark Hill Reservoir	CH-9	3	3	3	4	2	2
	CH-10	2	2	2	2	2	2
	CH-11	6	5	6	10	2	2
	CH-12	10	10	9	12	6	2
	CH-13	7	5	7	12	2	2
	CH-14	2	2	2	2	2	2
	CH-15	2	2	2	2	2	2
	CH-16	2	2	2	2	2	2
	CH-17	2	2	2	2	2	2
	CH-18	2	2	2	2	2	2
	CH-19	2	2	2	2	2	2
	CH-20	2	2	2	2	2	2
	CH-21	2	2	2	2	2	2
	CH-22	2	2	2	2	2	2
	CH-23	2	2	2	2	2	2
	CH-24	2	2	2	2	2	2
Hartwell Reservoir	HR-1	2	1	1	3	1	3
	HR-2	2	1	1	3	1	3
	HR-3	3	2	1	6	1	3
	HR-4	2	2	2	3	1	3
	HR-5	2	1	1	3	1	3
	HR-6	2	1	2	2	1	2
	HR-7	2	1	2	2	1	2
	HR-8	1	1	1	1	1	2

MF DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS		GEOMETRIC MEANS	
		SEASON 1968[a]	NON-SEASON 1967[b]	SEASON 1968[a]	NON-SEASON 1967[b]
Chatooga River	CT-1	100	80	90	60
	CT-1A	550	*	160	*
	CT-2	50	520	50	270
	CT-3	40	140	30	120
Nottely River and Nottely Reservoir	N-13	80	110	80	80
	N-14	160	170	140	110
	N-15	1200	540	660	310
	N-16	3100	590	1300	400
	N-17	1700	570	940	370
	N-18	6200	200	2500	180
	N-18A	1700	5000	960	5000
	N-19	1800	20	1500	10
	N-12	970	*	890	*
	N-20	10	4	10	3
	N-21	20	10	10	10
	N-22	140	160	70	40
Toccoa River and Blue Ridge Reservoir	T-33	990	340	450	210
	T-32	1100	440	970	290
	T-31	730	500	680	280
	T-30	600	480	600	170
	T-29	850	460	660	250

MF DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968[a]	ARITHMETIC MEANS NON-SEASON 1967[b]	GEOMETRIC MEANS SEASON 1968[a]	GEOMETRIC MEANS NON-SEASON 1967[b]
Toccoa River and Blue Ridge Reservoir	T-38	290	*	270	*
	BR-23	10	7	4	6
	BR-35	6	30	10	10
	BR-34	20	200	8	40
	BR-24	4	300	3	120
	T-25	10	450	9	80
	T-26	70	450	50	50
	T-27	60	40	50	30
	T-28	2200	170	200	60
Chattahoochee River and Lake Lainer	75-23	30	10	20	10
	356-22	90	30	90	30
	17-19	1300	*	750	*
	75-21	420	230	320	160
	602-20	*	230	*	210
	255-17	580	120	410	110
	115-16	850	130	270	120
	S1759	680	860	440	660
	S2422	660	440	310	430
	600-7	*	*	*	*
	52-4	*	*	*	*
	284-5	*	*	*	*
	129-6	*	*	*	*
	60-3	*	*	*	*
	53-2	*	*	*	*

MF DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS		GEOMETRIC MEANS	
		SEASON 1968[a]	NON-SEASON 1967[b]	SEASON 1968[a]	NON-SEASON 1967[b]
Hiawassee River and Lake Chatuge	H-5	160	110	140	50
	H-6	110	150	100	120
	H-7	860	250	580	330
	H-8	980	250	820	190
	H-4	460	560	420	350
	LC-9	140	450	60	260
	LC-10	160	40	50	30
	LC-11	30	10	10	7
	LC-12	20	4	10	3
Savannah River below Lake Hartwell	HD-13	*	*	*	*
	29-12	10	*	9	*
	181-11	30	*	10	*
	82-10	20	*	20	*
	72-9	170	*	160	*
	600-8	100	*	60	*
Clark Hill Reservoir	CH-1	*	2	*	2
	CH-2	*	2	*	2
	CH-3	*	2	*	2
	CH-4	*	2	*	2
	CH-5	*	2	*	2
	CH-6	*	2	*	2

MF DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968[a]	ARITHMETIC MEANS NON-SEASON 1967[b]	GEOMETRIC MEANS SEASON 1968[a]	GEOMETRIC MEANS NON-SEASON 1967[b]
Clark Hill Reservoir	CH-7	*	2	*	2
	CH-8	*	2	*	2
	CH-9	*	3	*	3
	CH-10	*	2	*	2
	CH-11	*	6	*	5
	CH-12	*	10	*	10
	CH-13	*	7	*	5
	CH-14	*	2	*	2
	CH-15	*	2	*	2
	CH-16	*	2	*	2
	CH-17	*	2	*	2
	CH-18	*	2	*	2
	CH-19	*	2	*	2
	CH-20	*	2	*	2
	CH-21	*	2	*	2
	CH-22	*	2	*	2
	CH-23	*	2	*	2
	CH-24	*	2	*	2
Hartwell Reservoir	HR-1	*	2	*	2
	HR-2	*	2	*	2
	HR-3	*	3	*	2
	HR-4	*	2	*	2
	HR-5	*	2	*	2
	HR-6	*	2	*	2

MF DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968[a]	ARITHMETIC MEANS NON-SEASON 1967[b]	GEOMETRIC MEANS SEASON 1968[a]	GEOMETRIC MEANS NON-SEASON 1967[b]
Hartwell Reservoir	HR-7	*	2	*	2
	HR-8	*	1	*	1
	HR-9	*	1	*	1
	HR-10	*	1	*	1
	HR-11	*	1	*	1
	HR-12	*	1	*	1
	HR-13	*	1	*	1
	HR-14	*	3	*	3
	HR-15	*	2	*	2
	HR-16	*	2	*	2
	HR-17	*	2	*	2
	HR-18	*	2	*	2
	HR-19	*	2	*	2
	HR-20	*	2	*	2
	HR-21	*	2	*	2
	HR-22	*	2	*	2
	HR-23	*	2	*	2
	HR-24	*	2	*	2
	HR-25	*	2	*	2

*-Denotes insuffcient data to obtain mean
a-Recreation season-May 30th - September 2nd
b-Non-Recreation season-September 3rd - May 29th

APPENDIX G

SEASONAL COMPARISON - MPN

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968*	ARITHMETIC MEANS NON-SEASON 1967*	GEOMETRIC MEANS SEASON 1968*	GEOMETRIC MEANS NON-SEASON 1967*
Chatooga River	CT-1	70	270	60	180
	CT-1A	1400	*	250	*
	CT-2	70	1000	50	320
	CT-3	30	200	30	190
Nottely River and Nottely Reservoir	N-13	80	150	60	50
	N-14	320	500	230	410
	N-15	800	1500	960	410
	N-16	4200	2700	2300	920
	N-17	5100	6700	1800	1700
	N-18	9400	530	2000	340
	N-18A	9900	16000	2300	16000
	N-19	3400	30	2300	20
	N-12	1300	*	1300	*
	N-20	30	20	30	6
	N-21	20	20	20	20
	N-22	260	190	20	30
Toccoa River & Blue Ridge Reservoir	T-33	540	10700	270	3200
	T-32	1000	8400	80	2700
	T-31	940	7100	800	1300
	T-30	370	3200	360	560
	T-29	1900	1800	930	980
	T-38	580	*	440	*

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968*	ARITHMETIC MEANS NON-SEASON 1967*	GEOMETRIC MEANS SEASON 1968*	GEOMETRIC MEANS NON-SEASON 1967*
Toccoa River and Blue Ridge Reservoir	BR-23	5	10	3	4
	BR-35	5	3	3	3
	BR-34	10	5	10	4
	BR-24	2	70	2	50
	T-25	5	8100	3	280
	T-26	50	8000	40	390
	T-27	100	5400	90	650
	T-28	5200	1600	240	1500
Chattahoochee River and Lake Lanier	75-23	80	25	80	120
	356-22	210	90	150	70
	17-19	2600	*	1300	*
	75-21	370	1100	330	1000
	602-20	*	680	*	590
	255-17	1000	290	500	240
	115-16	2200	290	750	230
	S-1759	2500	1900	1100	1500
	S-2422	820	1300	500	1300
	600-7	*	*	*	*
	52-4	*	*	*	*
	284-5	*	*	*	*
	129-6	*	*	*	*

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968*	ARITHMETIC MEANS NON-SEASON 1967*	GEOMETRIC MEANS SEASON 1968*	GEOMETRIC MEANS NON-SEASON 1967*
Chattahoochee River and Lake Lanier (Contd.)	60-3	*	*	*	*
	53-2	*	*	*	*
	141-1	*	*	*	*
	FC1	48	268	*	145
	FC3	120,983	62,567	*	10,000
	BR1	68	371	21	24
	BR2	2,639	47	46	14
	BR3	814	112	77	33
	BR4	300	375	43	32
	BR5	22	76	8	13
	H1	188	6	56	*
	H2	466	7.7	142	*
	H3	241	12	64	8
	H4	119	8	240	*
	H5	103	16	28	11
	H6	14	3	8	*

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS		GEOMETRIC MEANS	
		SEASON 1968*	NON-SEASON 1967*	SEASON 1968*	NON-SEASON 1967*
Hiawassee River and Lake Chatuge	H-5	230	230	140	120
	H-6	140	160	100	130
	H-7	780	310	500	280
	H-8	1100	700	830	360
	H-4	500	1200	460	560
	LC-9	110	480	60	120
	LC-10	120	50	70	50
	LC-11	30	10	10	50
	LC-12	15	5	6	3
Savannah River below Lake Hartwell	HD-13	*	*	*	*
	29-12	5	*	7	*
	181-11	30	*	10	*
	82-10	30	*	30	*
	72-9	170	*	190	*
	600-8	90	*	80	*
Clark Hill Reservoir	CH-1	*	3	*	3
	CH-2	*	2	*	2
	CH-3	*	2	*	2
	CH-4	*	2	*	2
	CH-5	*	2	*	2

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968*	ARITHMETIC MEANS NON-SEASON 1967*	GEOMETRIC MEANS SEASON 1968*	GEOMETRIC MEANS NON-SEASON 1967*
Clark Hill Reservoir	CH-6	*	2	*	2
	CH-7	*	2	*	2
	CH-8	*	10	*	6
	CH-9	*	10	*	12
	CH-10	*	2	*	2
	CH-11	*	6	*	6
	CH-12	*	10	*	7
	CH-13	*	2	*	2
	CH-14	*	2	*	2
	CH-15	*	2	*	2
	CH-16	*	2	*	2
	CH-17	*	2	*	2
	CH-18	*	2	*	2
	CH-19	*	2	*	2
	CH-20	*	2	*	2
	CH-21	*	2	*	2
	CH-22	*	2	*	2
	CH-23	*	2	*	2
	CH-24	*	2	*	2
Hartwell Reservoir	HR-1	*	2	*	2
	HR-2	*	2	*	2
	HR-3	*	2	*	2

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS		GEOMETRIC MEANS	
		SEASON 1968*	NON-SEASON 1967*	SEASON 1968*	NON-SEASON 1967*
Hartwell Reservoir	HR-4	*	2	*	2
	HR-5	*	2	*	2
	HR-6	*	10	*	8
	HR-7	*	5	*	4
	HR-8	*	2	*	2
	HR-9	*	2	*	2
	HR-10	*	2	*	2
	HR-11	*	2	*	2
	HR-12	*	2	*	2
	HR-13	*	2	*	2
	HR-14	*	60	*	60
	HR-15	*	2	*	2
	HR-16	*	2	*	2
	HR-17	*	2	*	2
	HR-18	*	2	*	2
	HR-19	*	2	*	2
	HR-20	*	2	*	2
	HR-21	*	2	*	2
	HR-22	*	2	*	2
	HR-23	*	2	*	2
	HR-24	*	2	*	2
	HR-25	*	2	*	2

MPN DATA - COMPARISON OF FECAL COLIFORM DENSITIES AT INDIVIDUAL STATIONS BASED ON SEASONS

AREA	STATION	ARITHMETIC MEANS SEASON 1968*	ARITHMETIC MEANS NON-SEASON 1967*	GEOMETRIC MEANS SEASON 1968*	GEOMETRIC MEANS NON-SEASON 1967*
Lower Chattahoochee River	C 1	46	60	*	40
	C 2	150	445	*	200
	C 4	330	270	*	210
	C 5	52	564	*	88
	CCI	30	469	*	120
	CCII	77	735	*	235
	CCIII	30	1,150	*	370
Lower Flint River	F 1	72	103	*	63
	F 2	30	97	*	58
	F 3	130	302	*	200
	F 4	33	224	*	80
Piedmont Refuge	P 1	740	1,454	*	600
	P 2	4,275	2,073	*	1,100

APPENDIX H

SUMMARY OF COASTAL STATION DATA - MPN

COASTAL WATERS

MPN DATA - FECAL COLIFORM DENSITIES OF INDIVDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Savannah River	3	10,100	40	20	160,000	20	17
	4	41	28	20	230	20	22
	5	39	29	20	230	20	22
Ogeechee River	102	222	90	80	2,400	20	22
Little Ogeechee River	15	28	23	20	80	20	22
Vernon River	16	53	28	20	490	20	22
	29	30	23	20	130	20	22
	30	780	23	20	16,000	20	21
	31	28	21	20	80	20	21
	32	109	41	20	790	20	22
Wilmington River	34	311	45	45	5,420	20	22
	35	113	68	70	700	20	22
	41	150	48	30	1,720	20	22
	43	100	46	20	490	20	22
Half Moon River	44	148	50	20	1,300	20	22

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Jekyll Island	J-1	<20	---	<20	<20	<20	1
	J-2	<20	---	<20	<20	<20	1
	J-3	<20	---	<20	<20	<20	1
	J-4	<20	---	<20	<20	<20	1
	J-5	<20	---	<20	<20	<20	1
	J-6	<20	---	<20	<20	<20	1
Saint Simon's Island	S-1	<20	---	<20	<20	<20	1
	S-2	<20	---	<20	<20	<20	1
	S-3	<20	---	<20	<20	<20	1
	S-4	<20	---	<20	<20	<20	1
	S-5	<20	---	<20	<20	<20	1
	S-6	<20	---	<20	<20	<20	1

APPENDIX H

SUMMARY OF COASTAL STATION DATA - MPN

COASTAL WATERS

MPN DATA - FECAL COLIFORM DENSITIES OF INDIVDUAL STATIONS
COMPUTED FROM THE ENTIRE STUDY

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Savannah River	3	10,100	40	20	160,000	20	17
	4	41	28	20	230	20	22
	5	39	29	20	230	20	22
Little Ogeechee River	102	222	90	80	2,400	20	22
	15	28	23	20	80	20	22
Vernon River	16	53	28	20	490	20	22
	29	30	23	20	130	20	22
	30	780	23	20	16,000	20	21
	31	28	21	20	80	20	21
	32	109	41	20	790	20	22
Wilmington River	34	311	45	45	5,420	20	22
	35	113	68	70	700	20	22
	41	150	48	30	1,720	20	22
	43	100	46	20	490	20	22
Half Moon River	44	148	50	20	1,300	20	22

AREA	STATION	ARITHMETIC MEAN	GEOMETRIC MEAN	MEDIAN	MAXIMUM	MINIMUM	NO. SAMPLES
Jekyll Island	J-1	<20	---	<20	<20	<20	1
	J-2	<20	---	<20	<20	<20	1
	J-3	<20	---	<20	<20	<20	1
	J-4	<20	---	<20	<20	<20	1
	J-5	<20	---	<20	<20	<20	1
	J-6	<20	---	<20	<20	<20	1
Saint Simon's Island	S-1	<20	---	<20	<20	<20	1
	S-2	<20	---	<20	<20	<20	1
	S-3	<20	---	<20	<20	<20	1
	S-4	<20	---	<20	<20	<20	1
	S-5	<20	---	<20	<20	<20	1
	S-6	<20	---	<20	<20	<20	1